5ESS® Switch
Administration and Engineering Guidelines
5E14 and Later Software Releases

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1. INTRODUCTION

1.1 PURPOSE

These guidelines assist the switch administrator and traffic engineer in performing local switch administration functions for the Lucent Technologies *5ESS*® switch. These functions include:

- Data Administration
- Switch Surveillance
- Capacity Management
- Switch Resource Utilization
- Transition Management.

To perform these functions, the administrator must have a thorough understanding of the *5ESS*® switch architecture and its call processing operations. Additionally, the administrator must understand how to interpret the traffic measurements provided from the *5ESS*® switch and be able to react to developing trends in traffic patterns to prevent traffic blockage and to avoid equipment over-engineering.

This document describes the administrative facilities provided, and the administrative functions necessary to administer the *5ESS*® switch. Additionally, the operations and administrative interfaces which may be used to perform the administrative functions are described.

This document is also used by the traffic and equipment engineer for an overview of system architecture, engineering, and administration. Toll, Operator Services Position System (OSPS), commercial automatic call distribution (C-ACD), and attached processor (AP) services features administration details are beyond the scope of these guidelines.

NOTE: Be aware that not all administration and engineering information applies to each service provider. It is up to the individual switch administrator or traffic engineer to be aware of his/her area of concern.

1.2 UPDATE INFORMATION

> ***NOTE:*** **This document is currently undergoing significant structure and content changes. Please refer to the Network Administration and Support (NAES) web site at https://support.lucent.com/cgi-bin/gx.cgi/AppLogic+dns.custrepos?bu_id=NAES for the current schedule and any updates until the new Issue 16 is published.**

1.2.1 Reason for Update

This document is being reissued to address various ENEC/LUSAT Documentation Subcommittee review issues.

1.2.2 Supported Software Releases

In accordance with the *5ESS*® Switch Software Support Plan, the 5E13 software release is rated Discontinued Availability (DA) as of September, 2002. The information supporting 5E13 and earlier software releases is being removed over time, instead of concurrently, from all documentation.

If you are supporting offices that use a software release prior to 5E14 and you have a need for the information that is being removed, retain the associated pages as they are removed from the paper documents, or retain the earlier copy of the CD-ROM.

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All release specific information for software releases rated DA is archived. This information can be provided from our archives in the event of a customer's need. When a software release is rated DA, a level of essential technical support is maintained. Essential technical support is defined as supporting critical problems, as mutually defined by the customer and Lucent Technologies. Additional technical support may be negotiated through service contracts, if desired.

1.2.3 TERMINOLOGY

1.2.3.1 Communication Module Name Change

The term Communication Module (CM) has been changed to the Global Messaging Server (GMS), representing the new portfolio name of this particular module. The current names of the specific types of the GMS (the CM2 and CM3) have not been changed. Where the CM name has been used in a generic way within this information product, the name will be changed to GMS. Where the specific version of GMS (CM2 or CM3) is being described or mentioned, the name will not be changed. However, the GMS name may be added to the description in certain places as a reminder of the change, and that the particular version is a part of the overall portfolio. The following list provides some examples of how you may see these names used together:

- Global Messaging Server (formerly Communication Module)
- GMS (formerly CM)
- Global Messaging Server-CM2
- GMS-CM2
- Global Messaging Server-CM3
- GMS-CM3.

These name changes will be made over time as other technical changes are required. Also these changes may not be reflected in all software interfaces (input and output messages, master control center screens, and recent change and verify screens). Where the information product references these areas, the names are used as they are within the software interface.

1.2.3.2 *5ESS*®-2000 Switch Name Change

This *5ESS*® switch document may contain references to the *5ESS*® switch, the *5ESS*®-2000 switch, and the *5ESS*® AnyMedia Switch. The official name of the product has been changed back to the *5ESS*® switch. The documentation will not be totally reissued to change these references. Instead, the changes will be made over time, as technical changes to the document are required. In the interim, assume that any reference to the *5ESS*®-2000 switch or the *5ESS*® AnyMedia Switch is also applicable to the *5ESS*® switch. It should be noted that this name change may not have been carried forward into software-influenced items such as input and output messages, master control center screens, and recent change/verify screens.

1.3 ORGANIZATION

- INTRODUCTION: This section contains information about this document and other general information about *5ESS*® switch documentation.
- NEW FEATURES AND SOFTWARE UPDATES: This section provides information concerning software release specific documents for the 5E14 through 5E16.2 software releases.

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- CALL PROCESSING MEASUREMENT RELATIONSHIP: This section provides information on the *5ESS*® switch reports on traffic, plant, and service measurements used to monitor particular aspects of a switching system operations.

- MEMORY OVERVIEW: This section provides information on the *5ESS*® switch memory types, structures, and management.

- ADMINISTRATION AND ENGINEERING SUPPORT SUBSYSTEMS: This section has been deleted and references the 235-600-750 Output Messages Manual document, for further information on the *5ESS*® switch administration and engineering support subsystems.

- ENGINEERING AND ADMINISTRATIVE CONSIDERATIONS: This section provides information on the *5ESS*® switch engineering methodologies.

- INTRODUCTION TO RESOURCE UTILIZATION: This section provides information on the *5ESS*® switch resources.

- AM/CMP/CNI RESOURCE UTILIZATION: This section provides information for administering the *5ESS*® switch Administration Module (AM)/Communication Module Processor (CMP).

- CM RESOURCE UTILIZATION: This section provides information for administering the *5ESS*® switch and the *5ESS*® switch Compact Digital Exchange (CDX) Communication Module (CM).

- SM RESOURCE UTILIZATION: This section provides information for administering the *5ESS*® switch Switching Module (SM).

- RSM UNIQUE RESOURCE UTILIZATION: This section provides information on the *5ESS*® switch Remote Switching Module (RSM).

- SM-2000 UNIQUE RESOURCE UTILIZATION: This section provides information on the *5ESS*® switch Switching Module-2000 (SM-2000) capabilities.

- EXM-2000 UNIQUE RESOURCE UTILIZATION: This section provides information on the *5ESS*® switch Extended Switching Module-2000 (EXM-2000) capabilities.

- ADMINISTRATIVE SERVICES MODULE (ASM) AND DISTINCTIVE REMOTE MODULE (DRM) This section provides information on the *5ESS*® switch Administrative Services Module (ASM) and Distinctive Remote Module (DRM) capabilities.

- ISDN RESOURCE UTILIZATION: This section provides information on the *5ESS*® switch Integrated Services Digital Network (ISDN) architecture, design and implementation.

- PRIMARY SERVICE INDICATORS: This section provides information for key service indicators and traffic related thresholds that may be monitored by the administrator.

- GLOSSARY: This section defines the acronyms.

To avoid duplication, some references are made to other manuals and documentation. These documents provide additional information that may be of interest to the administrator, refer to 235-001-001, *5ESS*® *Switch Documentation Description and Ordering Guide* for a current list of these documents.

The Traffic and Plant Measurements, Appendix 1, 235-070-100A1 is no longer available. The information contained in this manual has been moved to the Output Messages Manual (235-600-750).

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1.7 REFERENCES

The following documents in the *5ESS*® Customer Documentation Set are referenced:

ASM User's Guide	235-200-145
ASM Data Server Sotware Guide	235-200-146
CNI Common Channel Signaling	235-200-115
DOPSMOD/Topaz Documentation	235-060-xxx
Feature Descriptions	235-190-xxx
Hardware Description	235-100-200
Hardware Change Procedures (Growth)	235-105-231
Hardware Change Procedures (Degrowth)	235-105-331
Output Messages	235-600-750
Recent Change Reference	235-118-xxx
Translation Guide	235-080-100

For small switch applications, the following documents should also be referenced:

Compact Digital Exchange (CDX) User's Guide	235-120-020

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Very Compact Digital Exchange (VCDX) User's Guide	235-120-120
Distinctive Remote Module (DRM) User's Guide	235-200-150

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2. FEATURES

NOTE: **This document is currently undergoing significant structure and content changes. Please refer to the Network Administration and Support (NAES) web site at https://support.lucent.com/cgi-bin/gx.cgi/AppLogic+dns.custrepos?bu_id=NAES for the current update schedule and any updates until the new Issue 16 is published.**The modular design of the *5ESS*® switch allows for the ongoing development of features and services expected in the telecommunications marketplace. For a complete description of all the features in each software release, refer to the *5ESS*® *Switch System Description,* 235-100-125, and the feature manuals in the 235-190-XXX series. Traffic and plant measurements are provided in 235-600-750 *Output Messages Manual*.

Only features impacting switch administration and engineering that is applicable to administration tasks are discussed in this document. Because this document is primarily intended for use by local/domestic switching applications, and to avoid duplication of text, the following packages are not covered in these guidelines:

- Toll features
- Operator Service Position System (OSPS) features
- Attached Processor (AP) Service features
- Very Compact Digital Exchange (VCDX)
- Wireless.

2.1 FEATURE AVAILABILITY

Table 2-1 provides a list of features that impact administration and engineering and the initial software release they are available.

Table 2-1 Software Release and Feature Availability

FEATURE	SOFTWARE RELEASE										
	14	14 FR1	14 FR2	14 FR3	15	15 FR1	15 FR2	15 FR3	16.2	16.2 FR3	16.2 FR3/ 4
99-5E-8382 Session Initiation Protocol (SIP) for Packet Trunking											X
99-5E-8308 OIU-IP										X	
99-5E-7140 Optical Interface Unit (OIU)									X		
99-5E-8242 256K ISUP Tandem Solution									X		
99-5E-7321 Egress Queueing for Trunks and Lines								X			
99-5E-7682 EAIU with Emergency Standalone Capability								X			
99-5E-7780 Trunk Group Register Expansion								X			
99-5E-7178 Line Time Slot Bridging (LTSB) Port Inter Work with Home Intercom							X				
99-5E-7571 XAIU Broadband							X				
99-5E-7693 High Water Mark (PO Percentage) in Traffic report of*5ESS* ® DLN							X				
99-5E-7727 XAIU Medium Traffic Configuration Option 2							X				
99-CP-4916 SS7-PSU Conversion							X				
99-5E-7712 Delete Constructed Features via Audit Tool						X					
97-5E-3228 CM3 Base					X						

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99-5E-4288 Optically Extended Control and Data Unit					X						
99-5E-7150 Unidentified Call Rejection Feature					X						
99-5E-7301 Port Peripheral Control and Timing Facility Interface from International to North American Region (NAR) Market					X						
99-CP-4246./A/G/L/M Signaling Switch 7 Packet Switch Unit					X						
99-5E-7115 Advanced Services Platform Mid Call Event Detection				X							
99-5E-7210 1000 Block Number Pooling Using Number Portability				X							
99-5E-7469 II/OLI Delivery for National ISDN PRI				X							
99-5E-7447 Call Waiting Tone for Forwarded Call - Call Screening			X								
99-5E-4340 Increase *5ESS*® TRFC30 Buffer Size			X								
99-5E-7000 Increase Data Limits Selected Traffic Sections			X								
99-5E-7726 XAIU Medium Traffic Configuration Option 1			X								
99-5E-2652 Forwarded Call - Call Screening		X									
99-5E-3850.V Distinctive Remote Module		X									
99-5E-4187 Routing Enhancement Final Route Trigger		X									
99-5E-4596 MultipleX Access Interface Unit		X									
97-5E-4286 PH22 (PH20-16 Base)	X										
97-CP-4246.K SS7/PSU Link Enhancements	X										
99-5E-4720 Flexible Assignment of DCTU/PMU Ports to MMSU Shelves	X										

2.2 5E14 SOFTWARE RELEASE

2.2.1 Significant Features

2.2.1.1 (97-5E-4286) PH22 (PH20-16 Base)

This feature provides a PH22 base system which includes the PH22 hardware and necessary software to make the PH22 bootable and maintainable in a system lab. PH22 adds another protocol handler (PH) type to the family of PHs available in the PSU environment. The PH20-16 version requires an I/O module with 64-time slot capability, a processor module with the 66 megahertz version of the 68060, and a memory module with 16 megabytes of RAM.

In the PHS project, there is a need for a PH20-16 acting as a QPH and a PH20-16 with an ISDN image for packet data. The addition of the QPH image to the PH20-16 allows improved engineering of this resource in the PHS environment as well as other large CCS offices. Likewise, addition of the ISDN image to the PH20-16 allows improved engineering for the expected packet traffic in the subsequent phases of the PHS project. The specific PH channel type for packet data is the external packet switch channel group. This work provides the CCS software image for the PH22 (PH20-16).

The requirements for this new image are the same as for the PH6. The PH22 must be able to coexist with all previous PH images. This feature provides the same capabilities on the PH22 as are currently available on a PH6. Other work items will be used to enhance the image to support more links.

2.2.1.2 (97-CP-4246.K) SS7/PSU Link Enhancements

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This feature adds enhancements to the SS7 PSU signaling platform. The feature achieves feature parity with capabilities offered on the common network interface (CNI) signaling platform. These enhancements are as follows:

(1) Signaling link selector (SLS) code expansion: This feature enhances the SS7 PSU load sharing procedures to support the 8-bit code field and that traffic can be load shared evenly across the available links.

(2) Increase link set size to 16 links.

(3) Label A/E/F links: CNI provisioning allows the customer to label signaling links to a link type (A, E, or F) as defined in *ANSI*® specifications. The labeling of the link affords two items:

- The E and F link types can be secured and thus deployed by customers that purchase them
- The customer can easily identify the type of link and take appropriate action if problems arise.

(4) ISUP message handling in the PSU: Existing CNI procedures allow message transfer part (MTP) to respond with ISUP release (REL) messages to fail incoming call set-up requests when it determines it cannot route the message to the appropriate SM. ISUP code is introduced in the signaling terminal protocol handler (STPH) to support his capability.

This feature supports any SS7 PSU configurations and environments of the *5ESS*®, CDX, and VCDX switches. Since the SS7 PSU signaling platform is functionally transparent to the end user, no changes in the subscriber interface or the dialing plan are required. This signaling platform can be operated, administered, and maintained solely by service provider personnel. However, changes in areas such as Recent Change/Verify procedures, output messages, and maintenance tools that support these procedures will require additional training for service provider personnel.

2.2.1.3 (99-5E-2652) Forwarded Call - Call Screening

This feature is a switch based feature that allows subscribers to monitor forwarded calls by the call forward don't answer (CFDA) and/or CFBL services without the calling party's knowledge. With this feature, the subscriber has the option to either intercept the forwarded call, or allow the call to be answered by the forward-to-DN feature, assuming a voice message system (VMS) is in place. This provides the subscriber with an answering machine service equivalent and voice mail parity.

NOTE: It is the service provider's responsibility to ensure that the forward-to-DN, provisioned on the CF sub-features with CS enabled, is the DN of a VMS.

After this feature is installed on the line, the subscriber may activate/deactivate the forwarded call - call screening (FCCS) service by dialing the appropriate access codes. Once this feature is activated, a FCCS alert notifies the subscriber when a call is forwarded by the CFDA or CFBL service and enables the subscriber to monitor the call. The subscriber may deactivate this feature at any time, which results in the elimination of the FCCS alert and prevents the call from being monitored.

The FCCS feature is available to residential and business subscribers with individual analog lines, and is **not** offered to the following:

- ISDN lines
- Shared analog lines
- Coin lines
- Attendant lines

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- Multi-party lines
- Lines with line time-slot bridging (LSTB)
- Lines with series completion.

When FCCS is activated and a call is forwarded from a subscriber's line by CFDA with a stable path established between the calling party and the VMS, the switch performs the following:

- Reserve a three port conference circuit
- Provide CS alerting at the CS subscriber's station
- Initiate the screening phase timer (TSCREEN).

The FCCS feature requires an available three port conference circuit to enable a three-way connection between the FCCS subscriber, the calling party, and the VMS, with the subscriber being limited to one-way communication (listen only). Without the three-port conference circuit, FCCS monitoring is prohibited and the FCCS feature operation ends with the forwarded call being unaffected.

2.2.1.4 (99-5E-3850.V) Distinctive Remote Module (DRM)

The distinctive remote module (DRM) provides the customer with additional operating capability of a remote SM, without the addition of expensive umbilicals. The DRM coexists with other *5ESS*® switch remote modules (those remoted using the TRCU2 or TRCU3, RSMs, or ORMs). The functionality and capacity of the existing *5ESS*® switch are not impacted or modified by the introduction of this feature. At the DRM switch, all line-to-line calls are intra-switch, in the conventional sense. All outgoing calls from a DRM to other network elements, including the host, must be carried on inter-switch trunks. The DRM feature addresses the configuration of the network for which all voice and user data traffic at the remote is essentially confined within the area near the remote switching equipment. Any other traffic, voice, or user data between the DRM and the host office or any other cp-node must be transferred over interoffice trunks. The DRM provides integration (operation, administration, maintenance, and Provisioning) while also providing modular, non-integrated call processing capability. This feature introduces the concept of a call processing node, or call processing node, and a virtual switch, in the sense that it is administered as part of a host switch (the virtual switch), but otherwise, functions like an independent switch (the cp-node). As a result the DRM may be deployed in the same manner as other remotes provided they do not share with any other network elements and are not part of a cluster. They can share administrative and maintenance functions and resources.

2.2.1.5 (99-5E-4187) Routing Enhancement Final Route Trigger

The route index (RTE) feature adds the capability to query an AIN service control point (SCP) when a route index list is exhausted. This allows the service provider to control subsequent treatment of the call through logic at the SCP. The SCP then performs several options that include the following routing processes:

- Return a new routing number
- Private route
- Direct the *5ESS*® switch to tear down the call.

When the last route index attempt is unavailable, the final route (FR) trigger creates a **networkBusy** TCAP message to query the SCP. This feature is associated with the route index (RTI) feature using recent change/verify (RC/V).

The RTI feature is an enhancement that allows the end-user to "chain" a list of RTIs together. The route list

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consists of a key-list RTI and additional RTIs that are linked by their position in a route index list. Up to 11 additional RTIs may be used. The position of the RTI is used during routing to specify the sequence in which the RTIs are queried for a non-busy route. Therefore, when a route index is in use, the next RTI (NRTI) is not used to determine the next route.

With the activation of the RTI feature, the service provider has the following options:

- Number the RTIs up to 16,382 on all RC/V
- Associate the same trunk group number (TGN) with multiple RTI numbers.

2.2.1.6 (99-5E-4340) Increase *5ESS*® Switch TRFC30 Buffer Size

The TRFC30 report has encountered data limitations. This is a direct result of the 75,000 bytes limitation of TRFC30 buffer size and 32,000 bytes data limitation of the section size. The possible number of TRFC30 sections, which is 255, is also close to the limit. With the increase of Internet usage and wireless services, the ability to administer traffic loads for these switches needs to be increased. Expansion of the buffer allows for greater capacity to collect and transport information. This feature provides the capability to:

(1) Increase the overall traffic measurement buffer size from 75,000 bytes to 390,016 bytes.

(2) Increase the maximum number of sections created for the TRFC30 report from 255 sections to 65,535 sections (only 255 can be active).

(3) Increase maximum section size for a TRFC30 report from 32,000 bytes to 390,016 bytes for newly created or modified sections.

NOTE: **The increases in the traffic buffer limit and section size apply to the EADAS channel only, and does NOT apply to the alternate printer channel.**

This feature also expands Section 222 (DLINE) to a 390,016 bytes equal to the TRFC30 buffer space.

The service provider needs to support higher data link speeds in order to transfer the requested data within the required polling window. The minimum data link speed is 9600 bps. The external operating systems (OSs) need to use the new poll message 123 to send requests for TRFC30 data.

2.2.1.7 (99-5E-4596) MultipleX Access Interface Unit

The MultipleX Access Interface Unit (XAIU) resolves the Peripheral Interface Control Bus/Peripheral Interface Data Bus (PICB/PIDB) cable problem for the local AIUs installed on the SM-2000. This feature replaces the existing PICB/PIDB in local offices and minimizes the cables to each cabinet. It also allows a distance of up to two thousand feet between the AIU and the SM-2000. The XAIU feature introduces the following two new units to the system:

- PCT data exchanger unit (PDXU)
- XAIU.

The PDXU consists of two peripheral control and timing data exchanger (PCTDX) circuits that contain one peripheral link interface (PLI) paddle board, a PCT fiber pair and one fiber common data (FCD) circuit pack. The FCD is a new pack designed to terminate the PCT fiber optic link and distribute data to the XAIU shelves in the cabinet.

The XAIU is an AIU unit which resides in an XAIU cabinet. It uses a new version of the COMDAC that interfaces with the FCD.

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The XAIU cabinet differs from the local AIU and EAIU cabinet in that it has two FCD packs in the lower rear of the cabinet. The FCD packs are contained in a housing which is part of the PDXU unit. This unit supports two fiber pairs per cabinet, with each fiber pair carrying either a full PCT or one-half PCT. A full PCT consists of 768 time slots or 24 time slot groups (TSGRP) at 32 time slots per group, and one-half PCT has 384 time slots or 12 TSGRPs at 32 time slots per group. The following basic cabinet configurations are possible:

- A low traffic configuration with two one-half PCT PDXUs serving up to six XAIUs in the cabinet. Each XAIU in the cabinet may have up to two TSGRP pairs.
- A medium traffic configuration option 1 (MED) has six XAIUs per cabinet. It supports eight TSGRPs or four equivalent PIDBs per QCOMDAC. Refer to Section 2.2.1.13 , (99-5E-7726) XAIU MEDIUM TRAFFIC CONFIGURATION OPTION 1.
- A medium traffic configuration option 2 (MED1) has four XAIUs per cabinet. It supports six TSGRPs or three equivalent PIDBs per QCOMDAC. Refer to Section 2.3.1.11 , (99-5E-7727) XAIU MEDIUM TRAFFIC CONFIGURATION OPTION 2
- A high traffic configuration with two full PCT PDXUs serving up to four XAIUs in the cabinet. Each XAIU in the cabinet may have up to six TSGRP pairs.

Each configuration is pre-wired at the factory, therefore each shelf has an upper limit on the TSGRPs that serve it.

The XAIU is sold in several configurations and is suggested to be installed on an entire cabinet basis. When performing data growth, the PDXU must be grown in before the XAIUs in the cabinet that it serves. The data growth for each XAIU unit is done on an individual basis.

2.2.1.8 (99-5E-7000) Increase Data Limits Selected Traffic Sections

For more information about this feature, please refer to the *5ESS® Output Messages Manual* 235-600-750 document.

2.2.1.9 (99-5E-7115) Advanced Services Platform Mid Call Event Detection

This feature is a secured feature that provides service providers with the capability to create new services with Advanced Intelligent Network/Advanced Services Platform features on the *5ESS®* switch. The following events introduced by this feature are as follows:

- o_disconnect_called
- o_DTMF_entered

The o_disconnect_called event is associated with the ASP Originating Busy/No Answer Subsequent Event Detection Feature, 99-5E-1576A. The service control point (SCP) uses this event to request the switch to monitor the call for when the called party hangs up. This request prompts the *5ESS®* switch to report back to the SCP when the request is completed. The SCP has the option to instruct the *5ESS®* switch to plan an announcement, play an announcement and collect digits, or to route the call to another location.

The O_DTMF_Entered event is used by the SCP to monitor DTMF input from the calling party. The SCP may request either a specific digit string, which is one to four digits in length, or any digit string of a specified length.

This feature allows an AIN service that uses the next event list(s) (NEL) to expand by adding two new midcall events. With the addition of these events, the NEL service remains open during an answered call until either one of the following occurrences:

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- The event is detected.
- The call ends.
- Another defined event causes the closure of the NEL before detecting the event.

2.2.1.10 (99-5E-7210) 1000 Block Number Pooling Using Number Portability

The purpose of this feature is to increase the number of NPA-NXX-Xs that is opened on the *5ESS*® switch. The assignment of numbers to service providers in blocks of one thousand may improve the utilization of number resources compared to the existing practice of assigning numbers in blocks of ten thousand. Numbering resources may last for a longer period of time when the total number of NXX codes assigned is fewer than the a full NXX code assigned to each service provider within a pooled environment.

This feature provides local exchange carriers (LEC) with a provisioning method to use in a thousand block number pooling environment. This feature is available beginning with the 5E14 FR3 and later software releases.

This feature enables LECs to establish their telephone number database in a pooling environment. In a pooling environment where a NPA-NXX may be shared by as many as ten LECs, one of the LEC switches must be designated the Code Holder for the NPA-NXX (10,000 numbers). Other switches sharing the NPA-NXX are designated Block Holders. The code holder switch may also be designated a block holder for one or more of the thousands blocks of the NPA-NXX. With SFID 530, a SP can designate switches as code holders and/or block holders.

In a pooling environment, a SP can only assign numbers to subscribers from blocks it is allocated. SFID 530 provides a method for the SP to designate those blocks it may use for number assignment (RESERVED) and those blocks it may not use for assignment (PORTED OUT).

SFID 530 also provides methods for the SP to designate hundreds groups and individual DNs as RESERVED or PORTED OUT. Providing these designations at the hundreds group and individual DN level allows the SP to mark ported out hundreds groups or individual DNs. These lower level designations also help to establish correct error handling in a number portability environment.

SFID 530 thus provides the SP with methods to do the following:

- Designate switches as code holders and/or block holders
- Mark thousands blocks RESERVED or PORTED OUT
- Mark hundreds groups RESERVED or PORTED OUT
- Mark individual DNs RESERVED or PORTED OUT
- Allow switches to provide correct error handling in a NP and number-pooling environment.

2.2.1.11 (99-5E-7447) Call Waiting Tone for Forwarded Call - Call Screening

This feature is an enhancement of feature 99-5E-2652, Forwarded Call - Call Screening (FCCS) Feature, located in the 5E14 Release, and is available to analog subscribers only. This feature enables FCCS subscribers to receive call waiting tones during the monitor phase of FCCS. This enhancement allows the subscriber to have the option to ignore or answer the call waiting tone by using the flash-hook, which places the monitored call on hold and switches the FCCS subscriber to the call-waited party.

NOTE: The activation of this feature does not allow the FCCS subscriber to intercept monitored calls,

which is a capability offered by the FCCS feature, 99-5E-2652.

2.2.1.12 (99-5E-7469) II / OLI Delivery for National ISDN PRI

This feature allows the *5ESS*® switch to send the interexchange identification (II) / originating line information (OLI) to an external platform. The platform may be referred to as an adjunct or service node, and is connected to the *5ESS*® switch by a national PRI trunk group. This feature is a terminating primary rate interface (PRI) feature only and is activated when the secured feature identification (SFID) is turned **on**.

This feature is provisioned on the terminating PRI trunk group with a new trunk group indicator. The implementation of this feature allows the *5ESS*® switch to include the II/OLI information with the outgoing PRI SETUP message.

For further information on this feature, please refer to the 235-190-XXX, Feature Descriptions document.

2.2.1.13 (99-5E-7726) XAIU Medium Traffic Configuration Option 1

2.2.1.13.1 Feature Overview

The XAIU Medium Traffic Configuration Option 1 (MED) feature provides the associated development, documentation, and testing effort required for a 6 unit 8 TSGRP XAIU configuration.

2.3 5E15 SOFTWARE RELEASE

2.3.1 Significant Features

2.3.1.1 (97-5E-3228) CM3 Base

The purpose of this feature is to replace the Communications Module (CM1, CM2, CM2C/CDX) of the *5ESS*® switch and offer the following capabilities:

- Provides CM2 equivalent functionality
- Provides Communications Module messaging capacity to support AM evolution
- Increases Communications Module fabric capacity up to 3 times the CM2.

For additional information on this feature, please refer to Chapter 9 of this book.

2.3.1.2 (99-5E-4288) Optically Extended Control and Data Unit

The Optically Extended Control and Data Unit (OXU) feature provides the ability to connect peripheral units to a SM-2000 using PIDBs and PICBs with optical links. This feature allows the peripheral units to be up to 2,000 feet away from the SMC cabinet of the SM-2000, and the reuse of peripherals in SMs by increasing the previous 28 feet distance limit, which minimizes the total number of SM-2000s needed for an office upgrade. As a result, peripheral units on different floors or rooms within an office may be connected as long as the 2,000 feet limitation is maintained.

The SM-2000 supports up to 8 OXUs, however, not all 8 OXUs can be equipped with 5 XDXs or 3 CIs due to the combined maximum limit of 21 DXs and XDXs or 13 CIs equipped on the SM-2000 and OXU. In addition, the SM-2000 and OXU are capable of supporting up to 12 fully loaded DLTU24s and 16 DCLUs with 6 RTs per DCLU.

The OXU is physically located in the SMC or LTP cabinet. At this time, the OXU does not support DPIDBs until the MCTU2 and MCTU3 are replaced with the SM-2000. With the introduction of the OXU feature, the

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following hardware components, and their functions are associated:

- The DPLI paddle board does the conversion from the optical PCT link to the electrical TSI links for the XDX packs of the OXU. The DPLI paddle board interfaces with the associated XDX circuit pack and is located behind the pack. The maximum number of DPLI paddle boards installed on the back of a OXU shelf is ten, one per XDX pack.
- The OCDCOM is a modified XCDCOM circuit pack that interfaces with the new OCDCL control link. The OCDCOM packs are cross-coupled in timing, and provide system timing the OXU shelf. There are two OCDCOM packs installed on a OXU shelf.
- The APCO is a modified APCX circuit pack that has the capability to interface with up to eight OCDCL control links. There are two APCO circuit pack installed in the SM, one per side.
- The CPLIA paddle board does the optical-to-electrical (O/E) and electrical to optical (E/O) conversion to/from up to eight OCDL links at the SMC-2000. It is installed at the APCO circuit pack for each link connected to an OXU. There may be up to eight CPLIA paddle boards installed per APCO pack. Each APCO may handle up to eight OXU links.
- The CPLIO paddle board does the O/E and E/O conversion to/from the optical OCDCL format to/from the electrical OCDCL format at the OXU. It is located behind and interfaces to the OCDCOM circuit pack. There are two CPLIO paddle boards connected to the back of an OXU shelf.
- The OXU unit includes the signals needed to cross-couple the timing between the OCDCOM circuit packs and provide unit clocks and syncs.

The OXU is not supported on CDX, but is allowed on the *5ESS*® switch and VCDX configurations.

2.3.1.3 (99-5E-7150) Unidentified Call Rejection Feature

This feature is a new Local Area Signaling Service (LASS) feature that routes calls made to the user to an announcement when the calling party number is marked as "private". The user is not notified of the call and the announcement usually indicates that the called party is not accepting calls from parties with private numbers. Calls where the calling party number is not available or is not marked as private are not affected, subsequently, only calls marked as private are routed to the announcement.

The Unidentified Call Rejection feature (UCR) is available for analog users, and both business and residential customers may have access to the feature. The following additions are identified for this feature:

- ISDN BRI/DSL and PRI support for users, including *5ESS*® switch ISDN feature buttons
- Access codes for activation/deactivation of UCR
- AMA recording on activation/deactivation of UCR
- General availability of UCR as a service provider option to requiring subscription
- UCR capability to be assigned as part of BRCS feature group
- UCR capability to be assigned to multiline hunt group members (group DN and individual non-hunt DNs)
- UCR support to screen immediately on interswitch activation of automatic callback and automatic recall
- Option to return answer supervision for calls rerouted to the UCR announcement

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- Traffic measurements on activating/deactivating UCR and on routing calls to the UCR announcement
- Capability of dialing account codes and authorization codes upon activating/deactivating UCR.

2.3.1.4 (99-5E-7178) Line Time Slot Bridging (LTSB) Port Inter Work with Home Intercom

2.3.1.4.1 Feature Overview

The Line Time Slot Bridging (LTSB) Port Inter Work with Home Intercom (99-5E-7178) feature is an enhancement to the current *5ESS*® Switch Line Time Slot Bridging (LTSB) feature. This feature will allow the feature Home Intercom and Single Line Variety Package to be assigned to and used on one directory number (DN) LTSB lines. This feature does not modify the two DN LTSB line service.

The Home Intercom and Single Line Variety Package includes:

- Home intercom basic
- Intercom code dialing
- Selective intercom dialing
- Selective call transfer
- Dialable hold.

2.3.1.4.2 Software Release Availability:

This feature is available with the 5E15 FR2 software release. This feature must be secured separately by the switch using the standard feature security mechanism [RC/V View 8.22 (SECURED FEATURE UPGRADE)]. The secured feature ID number is 575.

2.3.1.4.3 Transition Management:

Not applicable.

2.3.1.4.4 Engineering Considerations:

The use of tone transceiver circuits [or voice band services (VBS) circuits for SM-2000] are needed for analog visual MWI, ICLID, and CND features which will now be allowed on LTSB lines. Transceiver (or VBS) circuits are needed when applying an analog visual MWI or providing an ICLID or CND display. For LTSB lines, both the associate and the lead modules need to have transceiver (or VBS) circuits available for each line which may increase the number of circuits normally needed for a single non-LTSB line.

2.3.1.4.5 Memory Usage:

No impact.

2.3.1.4.6 Resource Impact:

This feature increases the use of tone transceiver circuits [or Voice Band Services (VBS) circuits].

2.3.1.4.7 Administration Considerations:

Assignment of enough transceiver (or VBS) circuits to support LTSB and other features which require their use depending on the feature penetration in the field.

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2.3.1.4.8 Measurements and Primary Service Indicators:

2.3.1.4.8.1 New Measurements:

No new measurements.

2.3.1.4.8.2 Modified Measurements:

TRFC30 Section 72:
For one DN LTSB lines subscribing to Caller ID on Call Waiting, the switch provides the DNMSGS traffic measurement peg. This count description has been modified to clarify the following:

This count gets incremented when CIDCW information is delivered to either the lead or non-lead LTSB line, thus, the count gets incremented only once for the same call since neither the lead nor the non-lead line will be call waited if both are bridged onto the same call.

Refer to 235-600-750 *Output Messages Manual* for additional measurement information.

2.3.1.4.9 Network Management:

No new requirements.

2.3.1.4.10 Engineering Tool Specifics DOPSMOD/TOPAZ:

Use TOPAZ, Release 2 to order the secure feature ID number.

2.3.1.4.11 Operational Support Systems:

No new requirements.

2.3.1.5 (99-5E-7301) Port Peripheral Control and Timing Facility Interface from International to North American Region Market

This feature enhances the *5ESS*® switch by providing a multi-use interface to terminate loosely coupled access services and transport products onto the SM-2000 switching fabric. The peripheral control and timing facility interface (PCTFI) acts as an internal interface for line and trunk side applications that must be terminated by the *5ESS*® switch from a variety of peripheral unit types and applications.

In the future, this feature may provide the *5ESS*® switch with the capability to link to a SONET network and an evolution path to higher speed paths to the network. This may also provide a multiuse asset for future high capacity trunking and an interface with access and transport products that develop a PCTFI interface.

This feature is an internal interface to the *5ESS*® switch that is developed and deployed as an unsecured feature. It is implemented by using the PCT links from the SM-2000 TSI to directly terminate a variety of peripheral unit types and applications onto the *5ESS*® switch. As a result, the *5ESS*® switch supports this interface by creating a virtual unit at the TSI. The DNU-S and other intervening *5ESS*® peripheral units are not required because customer terminations supported on this interface appear at the TSI on the PCT link.

NOTE: All endpoints terminated by the PCTFI must be hardware and software compatible with the PCTFI interface.

With the activation of this feature, the following applies:

- The *5ESS*® switch recognizes the type of application that is being supported on the PCTFI.
- The *5ESS*® switch does not acknowledge the parent facility from which the PCTMUX system is dropping tributaries (T1s) on the PCTFI.

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- The *5ESS*® switch does not maintain status information, beyond that of the link, tributaries supported by the link, and the channels supported by the link, about internal elements of the PCTMUX system itself.
- The *5ESS*® switch is responsible for the initialization, recovery, and routine maintenance of the PCTFI, including the termination of the PCT link onto the PCTMUX system.
- The PCTMUX craft terminals and/or element manager supports the provisioning and maintenance of the PCTMUX system.
- The *5ESS*® switch craft terminals and/or element manager supports the provisioning and maintenance of the *5ESS*® product.
- A network management system capable of communicating with the *5ESS*® switch and the PCTMUX element managers may coordinate the provisioning activities.
- PCTMUX systems that terminate on the PCTFI support the interface specification (timing, alarms, diagnostics, etc.) for the PCTFI.
- The transport network interface (SONET) does not extend onto the PCTFI.

Initially, the PCTFI is developed from a MaxTNT 4 *7R/E*™ packet driver, which is the first peripheral product to develop the direct PCTFI interface capability in the NAR market, to drop T1 tributaries onto the *5ESS*® switch.

The introduction of this feature impacts the operations systems that support the *5ESS*® switch in the NAR market by the following:

- A new SM-2000 peripheral unit type is developed. Externally, this new peripheral unit type exhibits many of the attributes of a normal peripheral unit type even though no new *5ESS*® switch hardware is being developed. These include the following:
  - New office equipment number string
  - New and modified Input/Output messages
  - New and modified MCC display pages.
- Physical location information is supported by the office database and in several existing Input/Output messages.

2.3.1.6 (99-5E-7321) Egress Queueing for Trunks and Lines

2.3.1.6.1 Feature Description:

This feature provides two enhancements to the GETS capabilities:

- GETS Office Queueing - This capability provides office-wide GETS queueing without having to specifically identify and provision individual trunk groups with GETS queues.
- GETS Egress Queueing - This capability provides GETS queue coverage, on an office-wide basis, for calls attempting to terminate to a private facility. It provides a better probability of completion to a GETS call which has fought its way across a congested or damaged network so that it does not necessarily die if the outgoing PF/PRI trunk group has no idle member.

For both enhancements, a per-trunk group exclusion attribute can be used to exclude a trunk group from the ability to enqueue calls in a GETS Queue Resource.

2.3.1.6.2 Software Release Availability

This feature is available with software release 5E15 FR3. This feature is not a secured feature and is not dependent upon unlocking other secured feature IDs (SFIDs).

NOTE: Activation of Feature 99-5E-3945 is not required for 99-5E-7321 to function properly.

2.3.1.6.3 Transition Management

Because the GETS queuing resource (QR) will make use of the same pool of queue slots available to other types of, it is important to identify a host switch module (SM) that has a sufficient number of available queue slots available for the desired QRs' size. An SM-2000 with little or no other queuing assigned would be an ideal choice.

The two capabilities of this feature, GETS egress queuing and GETS office queuing for public trunk groups (TGs), are each controlled by an option feature ID (OFID). OFIDs are administered on RC/V View 8.31 (OPTIONED FEATURES). Two new OFIDs have been added to the switch, 978 and 979 are responsible for the following:

Table 2-2 OFID States

OFID Number	State	
	Active	**Inactive**
978	GETS calls attempting to egress over busy PF or PRI facilities will attempt to queue in the GETS egress queuing resource.	GETS calls attempting to egress over busy PF or PRI facilities will not be queued in the GETS egress queuing resource.
979	GETS calls attempting to egress over busy public trunk groups which do not have a GETS TG queue assigned will attempt to queue in the GETS office queuing resource.	GETS calls attempting to egress over busy public trunk groups which do not have a GETS trunk group queue assigned will not be queued in the GETS office queuing resource.

2.3.1.6.4 Engineering Considerations

There are no engineerable components associated with this feature.

2.3.1.6.5 Hardware Requirements

No new requirements.

2.3.1.6.6 Resource Impact

No impact.

2.3.1.6.7 Administration Considerations

The maximum number of available queue slots for an SM is 255, and per SM-2000 is 4000. This maximum is the sum of queues of the same structure The following types of queues share this structure:

- Multi-line hunt group (MHLG)
- Private facility access (PFA)
- Trunk; simulated facility group

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- Automatic route selection (ARS)
- GETS HPC queues

NOTE: ACD queues do not share the same queue structures and so do not count toward this maximum. GETS HPC queues will share this structure and so does contribute toward this maximum.

Originating users whose calls queue for an idle trunk, either a public route to another office or terminating to a PBX, may experience longer than normal holding times, and may receive an audible announcement if the feature is configured by the switch owner to provide such an announcement.

2.3.1.6.8 Measurements and Primary Service Indicators

This feature adds a set of measurements in order to provide data concerning the usage of the GETS Queuing Resource for calls to private facility or PRI trunk groups. Calls using the GETS QR for public trunk groups will peg the existing GETS office measurements for queues.

Refer to 235-600-750 *Output Messages Manual* for additional measurement information.

2.3.1.6.8.1 New Measurements

The following new 30-minute measurements are provided in TRFC30: Section 17.

Table 2-3 New TRFC30 Measurements

Measurement Name	Description
HPC Egress Queue Attempts	The number of times a GETS call undergoing egress queuing attempts to go into the egress QR.
HPC Egress Queue Overflows	The number of times a GETS call undergoing egress queuing attempts to go into the egress QR but can not because the maximum number of calls queued for the target trunk group has already been reached.
HPC Egress Queue Abandons	The number of times a GETS call undergoing egress queuing is abandoned while in the GETS egress QR.
HPC Egress Queue Timeouts	The number of times a GETS call undergoing egress queuing times out of the GETS egress QR.
HPC Egress QR Overflows	The number of times a GETS call undergoing egress queuing attempts to go into the egress QR but can not because the maximum number of trunk groups for which the egress QR is queuing calls has been exceeded.
HPC Office QR Overflows:	The number of times a GETS call undergoing office queuing attempts to go into the office QR but can not because the maximum number of trunk groups for which the office QR is queuing calls has been exceeded.

2.3.1.6.8.2 Modified Measurements

None.

2.3.1.6.8.3 Related Measurements

2.3.1.6.8.3.1 Traffic

TRFC30: Section 55, queuing for trunk group measures and TRFC30: Section 56, trunk group queuing announcement measures.

2.3.1.6.8.3.2 Plant

PLNT 24: Part 6

2.3.1.6.8.3.3 Network Traffic Management

The following 5 minute measurements count HPC calls on a total office basis:

- Originating HPC call attempts
- Incoming HPC calls
- Terminating HPC calls
- Outgoing HPC calls
- Outgoing HPC calls to no circuit

2.3.1.6.9 Engineering Tool Specifics DOPSMOD/TOPAZ

Not applicable.

2.3.1.6.10 Operational Support Systems

Memory administration operational support systems are impacted due to:

- OFIDs which control whether GETS egress queuing for PF/PRI trunks and GETS office queuing for public trunks are active.
- Office parameters defining the characteristic of the GETS queuing resources.
- Trunk group attribute used to exclude a trunk group from office queuing/egress queuing.

NOTE: The use of HPC network capabilities is restricted in the United States and U.S. Territories to National Security/Emergency preparedness (NS/EP) users authorized by the Office of the Manager, National Communications Systems (OMNCS). End user deployment of these HPC network capabilities must be coordinated with the OMNCS at the following address:

Office of the Manager
National Communication System
Attn: GETS Program Office
701 South Courthouse Road
Arlington, VA 22204-2198
email: gets@ncs.gov

2.3.1.7 (99-5E-7571) Broadband XAIU

2.3.1.7.1 Feature Overview:

The Broadband XAIU feature allows XAIU to have the capability to support broadband services. The introduction of the XAIU as a narrowband or broadband interface unit. The broadband XAIU feature provides the ability to administer and maintain an XAIU cabinet equipped with broadband AIU shelves, ATM feeder mux (AFM) application pack(s) (AP), one or more xDSL high speed APs and some narrowband APs. This allows the customer to equip a broadband XAIU as a mixed services unit or a full data service unit.

2.3.1.7.2 Software Release Availability:

This feature is available with Software Release 5E15 FR2.

2.3.1.8 (99-5E-7682) EAIU WITH EMERGENCY STANDALONE CAPABILITY

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2.3.1.8.1 Feature Description:

This feature allows the EAIU to continue limited call processing if the primary communication links (T1s) to the host switch are severed for any reason. Call processing is limited to emergency numbers such as 911. Other calls are routed to announcements. If the *5ESS*® switch detects a failure in both primary links, the *5ESS*® switch automatically switches into ESA. The EAIU automatically restores to normal operation when the first primary link restores to normal.

New hardware, the BZ-RS module, serves a temporary host switch. A miscellaneous cabinet co-located with the EAIU contains the BZ-RS module. The first 2 T1s of each EAIU connects through the BZ-RS module. The BZ-RS module may have a T1 trunk facility to the Public Switched Telephone Network (PSTN) for 911 connectivity. The BZ-RS module contains the announcements for ESA operation.

The BZ-RS has a separate element manager (EM) system, which optionally can be located at the EAIU site or connected via the host office ASM.

2.3.1.8.2 Hardware Description:

Table 2-4 Components

Unit	Description
S-Pack	The S-pack consists of a processor, switching matrix, DSPs for tone detection/generation, recorded announcements, protocol controllers, and E1s and T1s. The S-pack is housed in a miscellaneous cabinet with the 2 primary T1s/E1s from the switch terminating on it, and 2 other primary T1s/E1s going from it to the RCOMDACs in the EAIU (refer to Figure 10.7-2). If the RCOMDACs detect that communication on both primary T1/E1s has been lost, the S-pack will take control over the EAIU. When the S-pack has detected that T1/E1 communication has been restored, it will relinquish control back to the SM.
Element Manager	The S-pack has a separate management system, requiring a separate network of management communication links (refer to Figure 10.7-3). The element manager is based on a PC running Windows NT as operating system. Each S-pack is equipped with a modem that connects to the element manager. The connection is via dial-up lines or semi-permanent lines. For this purpose, one EAIU subscriber line must be reserved for the connection of the S-pack modem. In case the choice is for the use of semi-permanent lines, there is a pool of modems serving the element manager. By choosing dial-up connections, one modem is sufficient. A console is connected to the element manager for providing a human/machine Interface. There is only one console for managing all S-packs within a *5ESS*® switch. The S-pack element manager is able to manage up to 20 S-packs in the dial-up mode and up to nine S-packs in the semi-permanent line mode. The S-pack element manager obtains the *5ESS*® subscribers database via the advanced services module (ASM), using the Recent Change Operations Systems Server.
RCOMDAC	The entrance into emergency mode is controlled by the RCOMDAC. As each RCOMDAC detects it's own primary transmission facility is in failure it activates one of its distribution points. These two signals (one per RCOMDAC) are connected to the ESA distribution frame relay controls and the activation of these signals triggers the entrance into emergency mode. All call processing is now done in the S-pack, as if it were the host. In order to do that the S-pack implements the same protocol as used in the EAIU-host communication. When the S-pack has detected that T1/E1 communication has been restored, it will relinquish control back to the SM. While in emergency standalone mode of operation the following features are not supported: □ Line to line calls are not allowed, only line to emergency "911", which are routed over the emergency trunk route to an end office. □ Call forward, call transfer, and call waiting.

	□ Ground start lines (e.g. from PBX). □ ISDN lines. □ The S-pack module does not collect or report any statistics on completed calls.

2.3.1.8.3 Software Release Availability

This feature is available with Software Release 5E15 FR3. This feature like the EAIU, will only be available on SM-2000.

2.3.1.8.4 Transition Management

The element manager is used to set up provisioning of trunks on the S-pack module. RC/V View screens are provided that have a similar content to the *5ESS*® screens for provisioning of AIUs. Refer to the *Translation Guide* (235-080-100) for additional provisioning information.

2.3.1.8.5 Engineering Considerations

The S-pack module hardware and software system is in an inside plant environment in the same building connected to EAIU shelves that are in the same building The combined distances between the DSX and the EAIU cabinet and the S-pack module cannot exceed the current EAIU-DSX 450ft cable length requirement. The element manager is mountable near the host in a miscellaneous cabinet or in a stand alone rack.

2.3.1.8.6 Resource Impact

No impact.

2.3.1.8.7 Administration Considerations

One S-pack can support up to six EAIU's (3500 subscribers). One EAIU subscriber line must be reserved for the connection of the S-pack modem. The S-pack has to be aware of the directory number x equipment number (DNxEN) mapping for all subscribers present in the EAIUs for which it is responsible. The S-pack also acquires the subscriber billing number. This is the number reported as "calling party ID" in emergency services such as 911. It is also necessary to acquire the information on whether a given subscriber is configured as loop start or ground start.

The acquisition of data is accomplished by the S-pack element manager querying the *5ESS*® database. The frequency of the queries is a configurable parameter, so that it can be adjusted to meet the user needs.

2.3.1.8.8 Measurements and Primary Service Indicators

None.

2.3.1.8.9 Engineering Tool Specifics DOPSMOD/TOPAZ

Not applicable.

2.3.1.8.10 Operational Support Systems

During ESA mode of operation, no billing is performed.

2.3.1.8.11 Additional Documentation

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Refer to the following documents for detailed BZ-RS information:

241-500-009 BZ-RS User's Guide

241-500-010 BZ-RS Installation Manual

2.3.1.9 (99-5E-7693) High Water Mark (PO Percentage) in Traffic report of *5ESS*® DLN

2.3.1.9.1 Feature Overview

This feature provides additional traffic counts in TRFC30 Section 66: Direct Link Node. TRFC30 Section 66 provides measurement information for the Direct Link Node (DLN) for Common Network Interface (CNI) based Common Channel Signaling (CCS). This section provides measurements for average processor occupancy of the DLN per TRFC30 collection interval. A Direct Link Node may experience a large burst of traffic over a short time interval. This kind of traffic may cause a DLN overload, but prior to this feature TRFC30 Section 66 did not report bursty data.

To address this problem, this feature modifies TRFC30 Section 66 measurements as follows:

- Add counters APMAX and APMXTM.

2.3.1.9.2 Software Release Availability:

This feature is available with software release 5E15 FR2. This is not a secured feature, therefore, new counters added by the High Water Mark feature will be available for all customers that are using the CNI platform for CCS7.

2.3.1.9.3 Transition Management:

Not applicable.

2.3.1.9.4 Engineering Considerations:

There are no engineerable components associated with this feature.

2.3.1.9.5 Hardware Requirements:

No new requirements.

2.3.1.9.6 Resource Impact:

The Application Processor in the Direct Link Node provides these peg counts. Allowing these additional counts impact the processor usage; however DLN memory is not an engineerable component.

2.3.1.9.7 Administration Considerations:

High occupancy peg counts should be investigated. A high occupancy may indicate the need to address link node usage.

2.3.1.9.8 Measurements and Primary Service Indicators:

2.3.1.9.8.1 New Measurements:

TRFC30 Section 66:

APMAX - Maximum Application Processor Occupancy. This counter reports the maximum (highest) occupancy ("high water mark") value that took place during the TRFC30 interval. This occupancy will be scanned every 6 seconds.

APMXTM - Time of Maximum Application Processor Occupancy. This counter reports the time the maximum occupancy occurred.

2.3.1.9.8.2 Modified Measurements:

None.

Refer to 235-600-750 *Output Messages Manual* for additional measurement information.

2.3.1.9.9 Engineering Tool Specifics DOPSMOD/TOPAZ:

Not applicable.

2.3.1.9.10 Operational Support Systems:

External operational support systems (OSSs) must be modified for the new counters in the existing TRFC30 Section 66 report.

2.3.1.10 (99-5E-7712) Delete Constructed Features via Audit Tool Feature

The Business and Residence Custom Services (BRCS) feature Audit allows customers to audit the usage of BRCS constructed features on their system, which enables the ability to delete unassigned constructed feature definitions. The following feature types are considered:

- Individualized dialing (IDP)
- Call waiting (CWT)
- Call forwarding (CFW)
- Terminal group (TGR)
- Time of day (TOD)
- Multiway (MWY)
- Pick up originating (PUT)
- Automatic route selection (ARS)
- Private facilities (PFA)
- Distinctive ringing (DR)
- Multi-line hunt group (MHG)
- Auto-call back (ACB)
- Modular queuing (QU)
- Precedence and preemption (PP)
- Account code (ACCT)

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- Message detail recording (MDR)
- Authorization code (ATH)
- LASS automatic call back (AC)
- LASS automatic recall (AR)
- Customer original traced (COT)
- Automatic customer station rearrangement (ACSR)
- Electronic delivery service (EDS)
- Message desk service (MDS)
- Display features (DISP)
- Line identification features (LID)
- ISDN intercom (ICM)
- Attendant control (ACTR)
- ID after IDP/SC split (ID)
- SC after IDP/SC split (SC)
- LASS selective call acceptance (SCA)
- LASS selective call forwarding (SCF)
- LASS selective call rejection (SCR)
- LASS selective distinctive alert (SDA)
- CPN features (CPI)
- Home intercom single line variety (HI)
- Redirecting number delivery (RND)
- Bulk calling line identification (BCLID)
- Advanced service interface (ASI)
- Advanced services platform originating (ASPO)
- Advanced services platform terminating (ASPT)
- Advanced services platform non-call (ASPN)

The BRCS feature audit checks the usage of BRCS constructed features by **MFTYPE**, defined in the previous paragraph. A report is generated that supplies information on whether a BRCS feature is being used and the specific TN associated with it. If a feature is not currently assigned to a TN, the feature may be removed.

NOTE: Recent Change no longer supplies maintenance functions such as checking feature usage and deleting constructed features if the feature is not used.

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In order for the BRCS feature to be deleted, there should be no references to the particular feature in the system. Once the audit feature tool verifies that a constructed feature is not used, there is an option to remove the feature. Craftshell user interface commands are added for the BRCS feature audit with the following options:

- All features - The audit checks all BRCS features.
- Given modular feature types (MFT) - The audit checks only features with the specified type.
- Given feature name - The audit checks the usage of one feature only.
- Deletion - The audit deletes one specified feature, must be used with "given feature name" option.

2.3.1.11 (99-5E-7727) XAIU Medium Traffic Configuration Option 2

2.3.1.11.1 Feature Description

The XAIU Medium Traffic Configuration Option 2 (MED1) feature provides the associated development, documentation, and testing effort required for a 4 unit 6 TSGRP XAIU configuration.

2.3.1.11.2 Software Release Availability

This feature is available with the 5E15 FR2 software release.

2.3.1.12 (99-5E-7780) Trunk Group Register Expansion

2.3.1.12.1 Feature Description

This feature introduces the new section TGN of TRFC30 traffic measurements report. This new section consists of the same set of counters as section TG (sections 12 and 41). The difference between TG and TGN is in the counter precisions. The new section has the double precision counts. The advantage of TGN section is that it was developed in TDC architecture and the component selectivity for this section was introduced as well.

To avoid a problem with compatibility of *5ESS*® switch with external OSSs, sections 12 and 41 are still supported. Which sections to take into collection are determined by the customer through the SFID activation/deactivation mechanism, however only one of them (TG or TGN) can be allowed for collection at a time.

2.3.1.12.2 Software Release Availability

This feature is available with software release 5E15 FR3. This feature must be secured separately by the switch using the standard feature security mechanism, RC/V View 8.22 (SECURED FEATURE UPGRADE). The secured feature ID number is 596.

2.3.1.12.3 Transition Management

Not applicable.

2.3.1.12.4 Engineering Considerations

There are no engineerable components associated with this feature.

2.3.1.12.5 Hardware Requirements

No new requirements.

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2.3.1.12.6 Resource Impact

No impact.

2.3.1.12.7 Administration Considerations

None.

2.3.1.12.8 Measurements and Primary Service Indicators

Refer to 235-600-750 *Output Messages Manual* for additional measurement information.

2.3.1.12.8.1 New Measurements

A new double precision measurement section has been added, TRFC30 Section 212: Trunk Group Number.

2.3.1.12.8.2 Modified Measurements

Activation of feature 99-5E-7780 activates the new. TRFC30 Section 212: Trunk Group Number and deactivates TRFC30 Section 12.

NOTE: Network Management counters are not impacted.

2.3.1.12.9 Tool Specifics DOPSMOD/TOPAZ

Not applicable.

2.3.1.12.10 Operational Support Systems

External operational support systems (OSSs) must be modified for the new TRFC30 Section 212: Trunk Group Number measurement report.

2.3.1.13 (99-CP-4246/.A/G/L/M) Signaling Switch 7 Packet Switch Unit

The existing SS7 on PSU architecture created island global switching modules (GSMs). An island GSM only supports sending/receiving SS7 messages for trunks terminated directly on the GSM. The enhancement feature provides a new GSM configuration known as the host GSM. The host GSM supports sending/receiving SS7 messages for trunks terminated on non-global SMs (NGSMs) using an internal common channel signaling message transport (CMT) architecture. The host GSM must be a SM-2000 and will not require message delivery protocol handlers (MDPH). The GSM configurations will be called signaling gateways.

The enhanced SS7 on PSU introduces the quad link packet switch protocol handler (QPH). The QPH must be a PH22 that connects to the quad link packet switch (QLPS) network via nailed-up time slots on the NCT2 links. Unlike other PHs the QPH does not require a spare, it operates in a load-shared mode with other QPHs in the same PSU. The engineering parameters are as follows:

- Maximum of 16 per host GSM-2000
- Maximum of 59 per office
- May be equipped in an island GSM-2000 or host GSM-2000.

The number of QPHs is calculated with the following equation:

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QPHs = (Message Switch Units (MSUs) per second / QPH Capacity) + 1

The QPH capacity is based on the MSU length in octets as shown in Table 2-5 .

Table 2-5 QPH Capacity

Ave. MSU Length	20-64	65-128	129-192	193-256	257-272
PH Capacity (msg/sec.)	1364	788	397	266	152

Additional engineering parameters for enhanced SS7 on PSU are as follows:

- Maximum of 16 GSM-2000s per office
- Host GSM-2000 must be equipped with PH22s
  - Recommended to be used for transport of SS7 messages only
- Global remote switch module (GRSM)
  - May only be an island GSM
  - Requires remote clock unit (RCU) for synchronization during stand-alone operation
- Signaling termination protocol handler (STPH)
  - Island GSM may be PH3 or PH22 (5E14)
  - Signaling links (SLs) should be terminated on different STPHs and PSU shelves (if equipped)
  - Engineered based on SL capacity and MSU throughput capacity
  - Maximum of 4 SLs per PH3/PH22
- SLs engineered at 40% occupancy or 14.4 CCS per link
  - Maximum of 32 SLs per GSM
  - Maximum of 308 SLs per GSM-2000.

The TRFC30 reports for SS7 on PSU are as follows:

- Section 203 (New) - Signaling Link Set Measurements
- Section 204 (New) - Signaling Network Performance
- Section 230 - Message Transfer Point (MTP) Signaling Links
- Section 233 - Signaling Connection Control Point (SCCP) Counts
- Section 234 - Point Code.

For additional detailed information on the SS7 on PSU feature, please refer to Sub-chapter 15.2 .

2.3.1.14 (99-CP-4916) SS7-PSU Conversion

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2.3.1.14.1 Feature Overview:

This feature enhances software in support of a procedure to flash cut SS7 signaling from a CNI platform to a host GSM provisioned in the office. For additional information describing the conversion procedure refer to Section 15.2.2.6.2 SS7 PSU2 in Multiple SM-2000.

2.3.1.14.2 Software Release Availability:

This feature is available in the 5E15 FR2 software release.

2.3.1.14.3 Transition Management:

The procedure to flash cut signaling from CNI to a host GSM is implemented in four phases:

(1) Host GSM installation for host GSM or island GSM conversion to host.

(2) Pre-cutover mode

(3) Cutover mode

(4) Post-cutover mode

2.4 5E16.2 SOFTWARE RELEASE

Refer to 235-190-400 *Feature Descriptions* for detailed descriptions of the significant 5E16.2 features.

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3. CALL PROCESSING MEASUREMENT RELATIONSHIP

3.1 GENERAL

The *5ESS*® switch software release generates, collects, and reports traffic, plant, and service measurements used to monitor particular aspects of a switching system operation over the following intervals:

- 5 minutes
- 15 minutes
- 30 minutes
- 1 hour
- 24 hours.

Measurements for 30-second and 5-minute intervals are also available for network management use. These measurements provide a summary of events that have taken place within the switching system. The control of scheduling and printout of measurement data is also performed by the software release.

NOTE: Traffic matrix data is not provided by the 1/1A *ESS*™ switches for the *5ESS*® switch. However, some measurements are automatic but others must be allowed. Refer to the 235-600-750 *Output Messages Manual* , for a complete discussion of Traffic 30 (TRFC30) reports.

3.2 VALIDATION

The following measurements from TRFC30 Section 1 (refer to 235-600-750 *Output Messages Manual*) are collected to allow the system data user to judge the reliability of the data provided by the system:

- Validity - STATUS.
- Number of 10-Second Scans - SCN10.
- Number of 100-Second Scans - SCN100.

The purpose of data validation is to determine the following:

- Validity of measurements for use in switch engineering and administration.
- Hardware or software problems that exist in the switch data collection equipment.
- Measurements are internally consistent.

Data validation in the *5ESS*® switch come in the forms of machine and manual validation. Machine validation is the automatic self-checks for possible errors by the switch. Manual validation is the calculation of the suspected measured data and the comparison of the results with the reported measured data. This is performed on the office basic call counts which includes originating, outgoing, incoming, and terminating calls. In order to perform this procedure, worksheets are provided (Figures 3-2 3-3 3-4 3-5) by Lucent Technologies and are recommended for use by telephone companies and/or service providers.

3.2.1 MACHINE VALIDATION

Machine validation is the process in which the *5ESS*® switch performs self-checks that ensure on-time data

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collection and no hardware machine errors occurred. No check is performed to compare the data with any other value. Machine validation measurements are reported in Figure 3-1

Figure 3-1 TRFC30 Machine Validation Measurements

The data validity field is used to indicate the detected measurements of a given report as either suspect or invalid. The *5ESS*® switch detects incomplete and invalid measurements from one of the following:

- Initialization in the Switching Module (SM), Administrative Module/Communication Module Processor (AM/CMP), or both
- Data base manager *read failure* message in the SM, AM/CMP, or both
- Failure to send poll messages to an SM
- Failure to receive data from an SM
- Invalid previous report (due to all of the preceding).

When one or more of these conditions occurs, the affected report is marked "DATA MAY BE INVALID". When none of these conditions occur, the report is marked "DATA IS VALID".

3.2.2 MANUAL VALIDATION

Manual validation is the process of using worksheets to calculate the suspect measured data and to compare the results with the reported measured data. To do this, worksheets are provided and recommended for use by the service providers. Although the traffic reports do not include all the measurements that are needed to validate every individual measurement against other measurements, some validation of measurements data are possible.

Manual validation is performed on the office totals (basic call counts) which include originating, terminating, incoming, and outgoing calls. Office total measurements provide a picture of the system as a total environment and an indication of system performance in terms of the number and the types of incomplete activities.

Figures 3-2 , 3-3 , 3-4 , and 3-5 provide the worksheets used to validate originating, incoming, outgoing, and terminating calls. The worksheets include Integrated Services Digital Network (ISDN) and other measurements and improvements.

In validation of office totals, ISDN circuit switching counts should be taken into account because ISDN office totals are included in the existing TRFC30 Section 5 totals. However, this does not apply to ISDN

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packet switching counts because packet switching counts are not included in these totals.

3.2.2.1 Precautions

The worksheet is only a guideline. It is not intended as a diagnostic tool, or to provide exact measurement comparison. This is because the counts for many on-going or just-completed calls are not reported or overlap on two reports. In addition, when comparing the data of different sections of the traffic report, all sections are not reported to the AM simultaneously. As a result, the skewing of the data may result between the AM, CMP, and the SMs within the reporting time. The manual check requires a thorough understanding of the registers where basic call counts are pegged. Knowing the office characteristics is also necessary.

This validation part does not take showering lines, quick disconnects, and Business and Residence Custom Services (BRCS) features into consideration. This is because some of the BRCS features in the *5ESS*® switch may peg more than one half call in certain cases. For example, a line with Shared DN feature pegs two terminating half calls and one originating half call when the lead DN is not the answering port. Therefore, caution is necessary when using the worksheet to validate the basic call counts of a heavy BRCS feature loaded office. Also, to have sufficient data for manual validations, more than a half hour of data must be considered.

Because of these reasons, the calculated figures and the reported measured data may not match exactly. The difference should usually be within 5 percent.

3.2.2.2 Procedures

The worksheets for manual calculation, Figures 3-2 , 3-3 , 3-4 , and 3-5 , are divided into four parts:

- Part 1 – Originating calls
- Part 2 – Outgoing calls
- Part 3 – Incoming calls
- Part 4 – Terminating calls.

The TRFC30 section numbers are provided in parentheses beside the measurement count(s) required. The steps provide a systematic comparison of the office data for validation.

Part 1 – Originating Calls, Figure 3-2 . The basic calculation procedure is to add all types of originating requests and compare the total with the sum of all calls that are sampled for dial tone delay. These two values should be approximately equal. Then, subtract the originating ineffective attempts for false starts and permanent signals from the originating requests. This value should be approximately equal to the Originating Office count and the Originating Half Calls total for all SMs. To obtain the Total System valid originating calls, subtract the customer dialed irregularities, abandoned partial dials and partial dial time-outs. The Total Originating to Outgoing calls is then calculated by subtracting the intra-office data from the Total System calls.

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Figure 3-2 Originating Calls

Part 2 □ Outgoing Calls, Figure 3-3 . Add the Total Originating to Outgoing calls from Part 1 to the office tandem calls count. Then compare the value to the sum of the Outgoing Half calls for all SMs and to the outgoing attempts for all trunk groups in the office. The three values should be approximately equal.

Figure 3-3 Outgoing Calls

Part 3 □ Incoming Calls, Figure 3-4 . Total all types of incoming requests and compare the value to the total incoming attempts for all trunk groups in the office. The values should be approximately equal. Then subtract the incoming false start and permanent signal counts from the incoming requests. This value should be comparable to the Incoming Half calls for all SMs and the Incoming Office count. By subtracting the abandoned partial dial and partial dial time-out counts the Total System Incoming calls is obtained. The Incoming to Terminating value is obtained by subtracting the tandem calls from the Total System calls.

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Figure 3-4 Incoming Calls

Part 4 □ Terminating Calls, Figure 3-5 . Add the Incoming to the Terminating value from the Part 3 to the Intra-office counts. This provides the Total System Terminating calls. Then subtract the terminating calls to busy to obtain the Total terminating attempts. This value is then compared to the terminating half calls and the total terminating call counts for all the line peripheral equipment.

Figure 3-5 Terminating Calls

3.3 ORIGINATING CALL FLOW

3.3.1 NON-ISDN CALL PROCESSING

The call processing of a non-ISDN originating call is shown in Figure 3-6 . When a subscriber originates a call by lifting the receiver, the SMP determines the specific line that changed state. The number of off-hook conditions is pegged by the TTORQ (3) and DPORQ (3) (TT and DP originating requests) counters.

Under control of the SM processor (SMP), the high-level service circuit (HLSC) is then accessed to

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perform the following tests:

- False cross and ground test.
- Power cross test.
- Continuity test.

When there is an attempt to access the HLSC, the PEGCT (8) (HLSC peg count) counter is pegged. If an HLSC cannot be obtained to run an originating short job, the SHTOVF (8) (short job overflow) counter is pegged. After the HLSC is seized, performs its tests, and is released, then a universal tone generator (UTG) is connected.

Dial tone is connected to the peripheral time slot associated with the channel circuit connected to the subscriber. The DTDSC (4) (dial-tone delay sample count) counter is a count of the originating calls or attempts. If the dial tone delay exceeds the 3-second threshold, the DTDPC (4) (dial tone delay peg count) counter is pegged. The number of attempts to access the tone decoder (TD) is measured by the PEGCT (TD peg count) (9) counter. If there was an unsuccessful attempt to access the TD, the OVFLOW (TD overflow) (9) counter is pegged.

When the originating party begins dialing, the channel that was previously connected to a UTG time slot is connected to a time slot for a universal tone decoder (UTD) in the local digital service unit (LDSU) or digital service unit model 2 (DSU2). If a LDSF or GDSU disconnect occurs before receipt of a digit, the FALST (6) [ORIGIN] (originating false starts) counter is pegged. If a time-out occurs before the receipt of a digit, the PERMSIG (6) [ORIGIN] (originating permanent signal) counter is pegged.

The PEGCT (5) [ORIGINAT] (originating calls peg count), ORGHC (13) (Originating Half Calls), and SMORIG (22) counter indicates the receipt of at least one digit for analog call originations. If a call is abandoned before enough digits are dialed, the PDABAN (6) [ORIGIN] (originating partial dial abandonment) counter is pegged or the PDTIMO (6) [ORIGIN] (originating partial dial time-out) counter is pegged if the interdigital timing was exceeded.

When the SMP determines that digit collection is complete, the digit scan of the UTD is disabled. If the digits are uninterpretable, the CDIRR (3) (customer dialing irregularities) counter is pegged. The digits are translated to determine if the call is interoffice or intraoffice. The PEGCT (5) [OUTGOING] (outgoing calls peg count) counter indicates calls to be sent to the network for completion including originating and tandem call attempts. The PEGCT (5) [INTRAOFF] (intraoffice calls peg count) counter indicates the number of calls to be completed within the *5ESS*® switch.

If a complete set of digits was received or was retrieved from the data base, but the phone went on-hook before the call completed or was rung, an ABAND (6) [ORIGIN] (originating calls abandoned) counter is pegged. If a call is sent to a reorder tone, the REORD (4) (calls to reorder peg count) counter is pegged. If a route request message cannot be sent to the AM/CMP the BLKOVD (4) (calls blocked during AM/CMP overload) counter is pegged and the call is sent to reorder. The CMP marks this field when the CMP cannot route a request message.

3.3.2 ISDN CALL PROCESSING

Figure 3-7 illustrates the call processing of an ISDN call. When an ISDN subscriber originates a call by lifting the receiver, the customer premises equipment (CPE) sends a Q.931 setup signaling message to the switch. The number of off-hook conditions for ISDN lines is pegged by the ORIGRQ (50 and 53) for Q.931 access lines and DTDSC (4) for Z-cards and TR008 /TR303 remote terminal (RT) lines. The HLSC is then accessed to perform the following tests for Z-cards and TR008/TR303 RT-lines only:

- False cross and ground test
- Power cross test

- Continuity test.

The Q.931 access lines do not access HLSCs on a per call basis. When an attempt is made to access the HLSC the PEGCT (8) counter is pegged. If an HLSC cannot be obtained to run an origination short job testing, the SHTOVF (8) counter is pegged.

For Z-cards and TR008/TR303 RT-lines only, after the HLSC is seized, tested, and released, a UTG is connected and PEGCT (9) TD is pegged. If access to the TD was unsuccessful, the overflow TD (9) counter is pegged. The Q.931 access lines use the CPE for tone generation or dial tone. The Z-cards and TR008/TR303 RT-lines follow the same originating call as a line in the LU.

Dial tone is generated at the CPE for Q.931 access lines when the switch sends a Q.931 setup acknowledge message to the CPE. Dial tone for Z-cards and TR008/TR303 RT-lines is connected to its PIDB time slot, and the DTDSC (4) counter is a count of Z-card originating calls. If dial tone delay exceeds 3 seconds, the DTDPC (4) is pegged.

For Q.931 access lines, the ORIGRQ (50 and 53) counters is a count of the originating calls. If the dial tone delay exceeds 3 seconds, the setup delay (53) counter is pegged. When the originating party on a Q.931 access lines begins dialing, the ORIGINAT (5), ORGHC (13), ORIGPC (50), and SMORIG (22) pegs when the first digit is received. If on-hook is detected before any digits are dialed, FALST (6) is pegged. If predigit time-out occurs, PERMSIG (6) is pegged. After the switch receives the first digit, the switch sends a Q.931 message to the CPE to turn off dial tone. If a call is abandoned before enough digits are dialed, the PDABAN (6) [ORIG] counter is pegged or the PDTIMO (6) [ORIG] counter is pegged if the interdigital timing value is exceeded.

When the SMP determines that the digit collection is complete but the digits are uninterpretable, the CDIRR (3) counter is pegged. The dialed digits are translated to determine if the call is interoffice or intraoffice. The pegcount [OUTGOING] (5 and 50) counters indicate when the call is to be sent to the network for completion, and the pegcount [INTRAOFFICE] (5 and 50) indicates that the call completes in the same office. If a complete set of digits is received but the calling party goes on-hook before the call is completed or before the called party is rung, an ABAND (6) [ORIG] counter is pegged. If the call is sent to reorder tone, the REORD (4) counter is pegged. If the AM/CMP is in overload and the call is throttled, the BLKOVD (4) is pegged, and the call is sent to reorder.

3.3.3 VALIDATION

This worksheet does not take showering lines, quick disconnects, and BRCS features into consideration. The originating may be validated following the steps shown in Figure 3-2 . Refer to the235-600-750 *Output Messages Manual*, for a complete discussion of TRFC30.

3.4 OUTGOING CALL FLOW

3.4.1 CALL PROCESSING

Digits are received from the line or incoming trunk. For most cases, the digits are collected in a UTD in the DSU2 or LDSU. Digit translation is performed to analyze destination routing.

The AM/CMP determines the destination trunk for the call and reserves a path between the SMs of the originating line and outgoing trunk. At this point, the *5ESS*® switch is ready to outpulse destination digits over the outgoing trunk.

The PEGCT (OUTGOING) (5) counter is pegged when calls are sent to the network for completion (including tandem). The OUTHC (13) (outgoing half calls per SM) counter is also pegged at origination. The calls that obtain an outgoing trunk are pegged on the OUTGO (12) (outgoing attempts) counter. If there is no available member of a shared trunk group, the OVFL (12) (trunk overflow) counter is pegged. Packet

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switching calls outgoing on packet trunks cause OUTPG (92) to peg. If an ISDN call is to complete out of the office, OUTPC (50) pegs.

After all digits are collected and the talking path is reserved, the AM/CMP processor prepares the digits to be outpulsed. Leading digits on the call can be deleted or prefixed as needed to change the digits on the call to those expected by the terminating office. The outgoing trunk is connected to a UTG. When a start signal is detected by the trunk, digit transmission begins. Digits are sent from the UTG over the outgoing trunk. After all digits are transmitted to the connecting office, the path to the UTG is idled.

3.4.2 VALIDATION

The outgoing calls can be validated by following the steps shown in Figure 3-3 . The values are taken from the TRFC30 report. The number in brackets refers to sections on the TRFC30 report. Refer to the 235-600-750 *Output Messages Manual*, for a complete discussion of TRFC30.

3.5 INCOMING CALL FLOW

3.5.1 CALL PROCESSING

The SMP determines the specific trunk that changed state. The number of off-hook conditions is measured by the C6INRQ (3), TUPRQ (3), ISUPRQ (3), (CCS 7), DPINRQ (3), MFINRQ (3), and RPINRQ (3) (dial pulse, multifrequency, and revertive pulse incoming requests) counters. The SMP determines that an incoming call was initiated.

If a revertive pulsing (RP) transceiver is needed, an attempt to connect an RP transceiver is measured on the PEGCNT (25) (RP transceiver attempt) counter. If an attempt to connect an RP transceiver is unsuccessful, the OVFLO (25) (RP transceiver overflow) counter is pegged. Because common channel signaling (CCS) sets up the path for C6INRQ, TUPRQ, and ISUPRQ trunks, a tone transceiver (60) from the LDSU2 is recommended for voice path assurance.

When an MF, DP or RP incoming trunk begins sending address signaling, the channel is connected to a time slot for a UTD in the DSU2 , LDSU, LDSF, or GDSU. If a disconnect occurs before receipt of a digit, the FALST (6) [INCOM] (incoming false starts) counter is pegged. If a time-out occurs before the receipt of a digit, the PERMSIG [INCOM] (6) (incoming permanent signal) counter is pegged.

For an incoming call, the TGIPC (12) (trunk group incoming) counter is pegged. The TGSILC (trunk group selective incoming load control) counter is pegged when there is a load control on a trunk group. The PEGCT [INCOMING] (5) (incoming calls peg count) counter indicates the receipt of at least one digit. The INCHC (13) (incoming half calls) counter per SM is also pegged at origination. The SMP performs digit analysis. If a call is abandoned before completion, the PDABAN (6) [INCOM] (incoming partial dial abandonment) counter is pegged or the PDTIMO (6) [INCOM] (incoming partial dial time-out) counter is pegged if the interdigital timing was exceeded. For a C6, ISUP, or TUP incoming call, the INCPEGCT (50), PEGCOUNT(INCOM) (5), and INCHC (12) pegs. If the call arrives on packet trunks, INCDMPC (93) and INCPC (69) pegs instead of INCPC (5, 12, and 50).

When the SMP determines that digit collection is complete, the digits are translated to determine if the call is tandem or terminating. The PEGCT [TANDEM] (5 and 50) (tandem calls peg count) counter indicates calls to be sent to the network for completion. The PEGCT [TERMINAT] (5, and 50) (terminating calls peg count) counter indicates the number of calls to complete to lines within the *5ESS*® switch including intraoffice call attempts. If the call arrives on packet trunks, PEGCNG [TANDEM] (93) and PEGCNT [TERM] (93) pegs instead of TANDEM and TERM in (5).

If an ABAND (6) [INCOM] (incoming calls abandoned) counter is pegged, a complete set of digits was received, but the call could not be completed because the incoming trunk abandoned.

3.5.2 VALIDATION

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The incoming calls can be validated following the steps shown in Figure 3-4 . The values are taken from the Traffic 30 (TRFC30) report. The number in brackets refers to sections on the TRFC30 report. Refer to the 235-600-750 *Output Messages Manual*, for a complete discussion of TRFC30.

3.6 TERMINATING CALL FLOW

3.6.1 NON-ISDN CALL PROCESSING

The TERMHC (13) (terminating half calls per SM), TERMATT (21) *SLC*® 96 carrier terminating attempts), and the TMCALLS (11) (terminating attempts per LU) counters are pegged.

Once a path is established between the two SMPs, the terminating SMP checks the busy/idle status of the terminating line and informs the originating or incoming SMP. If the call cannot be completed, the associated tones are sent to the called party by the DSU2 or LDSU of the originating or incoming SM. The unsuccessful attempts to access a concentrator A- or B-link is indicated by the TMBLK (11) (LU terminating blocking) counter. The unsuccessful attempts to terminate to the RT-lines because of the inability to access a time slot on the SDFI between the RT-lines and the DCLU or IDCU is indicated by the TERMBLK (21 or 139) (DCLU or IDCU terminating blocking counter).

Once the terminating call tests are completed, the terminating SMP sets the HLSC to provide ringing current for the terminating line. When an attempt is made to access the HLSC, the PEGCT (8) (HLSC) counter is pegged. The unsuccessful attempt to obtain the HLSC is indicated by the RNGOVF (8) (HLSC ringing overflow) counter. The calling party receives audible ringing tone from the terminating LDSU while the called party receives ringing under control of the terminating HLSC.

If a disconnect occurs after ringing was applied to the terminating line and audible ringing is returned to the calling party, the TCRNG (3) (terminating calls to ring with no answer) counter is pegged. If the line is busy, the TCBSY (3) (terminating calls to busy) counter is pegged. When a call is sent to intercept, the TCINT (3) (terminating calls to intercept) counter is pegged. If the called party answers, the TCANS (3) (terminating calls to answer) counter is pegged.

3.6.2 ISDN CALL PROCESSING

Figure 3-7 shows call processing of a terminating ISDN call. Once a path is established between the two processors, the terminating SMP checks the busy/idle status of the terminating line before informing the originating SMP. If the call cannot be completed, the associated tones are sent to the CPE of the calling party or to the trunk of the incoming SM. The unsuccessful attempts to set up a terminating path through the ISLU/ISLU2 or IDCU pegs TMBLK (49 or 139).

Once the terminating call tests are completed, the terminating SMP sets the HLSC to provide ringing for lines terminating on Z-cards and TR008/TR303 RT-lines. The switch sends a Q.931 message to a line terminating on Q.931 access lines enabling the called party CPE to ring itself.

If a disconnect occurs after ringing is sent to the called party and audible ring is returned to the calling party, the TCRNG (3) counter is pegged. When a call is sent to intercept, the TCINT (3) counter is pegged. If the called party answers, the TCANS (3) counter pegs.

3.6.3 VALIDATION

The terminating calls can be validated following the steps shown in Figure 3-5 . The values are taken from the TRFC30 report. Refer to the235-600-750 *Output Messages Manual*, for a complete discussion of TRFC30. The number in brackets refers to sections on the TRFC30 report.

3.7 REMOTE SWITCHING MODULE CALL PROCESSING

The remote switching module (RSM) is an SM located remotely from a *5ESS*® switch. The RSM configurations operate in either a linked or stand-alone mode.

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Linked mode refers to the normal operating condition of the RSM. While in the linked mode, any feature available at the *5ESS*® switch is also available at the RSM.

The stand-alone mode of operation is an optional feature that provides local service to the customer of the RSM when communications with the *5ESS*® switch is lost. Most of the BRCS features available in the normal linked mode of operation are also available in the stand-alone mode.

The ORIG (22) (remote module originating calls) counter is pegged when an originating request results in the receipt of at least one digit. The number of outgoing calls that are completed through the host SM from the RSM is measured by the OTG (22) (remote module outgoing calls) counter. An attempt to allocate an umbilical time slot for use in an intermodule call is measured by the UMPC (23) (umbilical time slot peg count) counter. If an attempt to allocate an umbilical time slot is unsuccessful, the UMOFL (23) (umbilical time slot overflow) counter is pegged. The INC (22) (remote module incoming calls) counter provides the number of incoming call attempts on the RSM through the host SM.

The SATIME (22) (remote module stand-alone time) counter provides the number of seconds the RSM was in stand-alone mode. If a call is blocked in the RSM because the RSM was in stand-alone mode, the OUTBLK (22) (remote module blocked calls) counter is pegged. The INCBLK (22) (RSM stand-alone call failures) counter measures the number of blocked calls in the AM/CMP because the RSM was in stand-alone mode.

3.8 SESSION INITIATION PROTOCOL (SIP) CALL FLOW

When the call processing software in the *5ESS*® switch determines that a call is to be routed to the Internet Protocol (IP) Network, then call processing establishes the call through the IP Network. This is done using the Session Initiation Protocol (SIP) signaling protocol over packet trunks connected to the Optical Interface Unit (OIU).

Refer to the 235-200-118 *Session Initiation Protocol for Packet Trunking - OA&M Manual* for more detailed information on SIP call flow.

3.9 KEY SERVICE INDICATIONS

The key service indicators are those indicators which give the administrator a quick view of the overall quality of service being provided to the subscribers. Refer to Section 16 , PRIMARY SERVICE INDICATORS AND MEASUREMENT THRESHOLDS.

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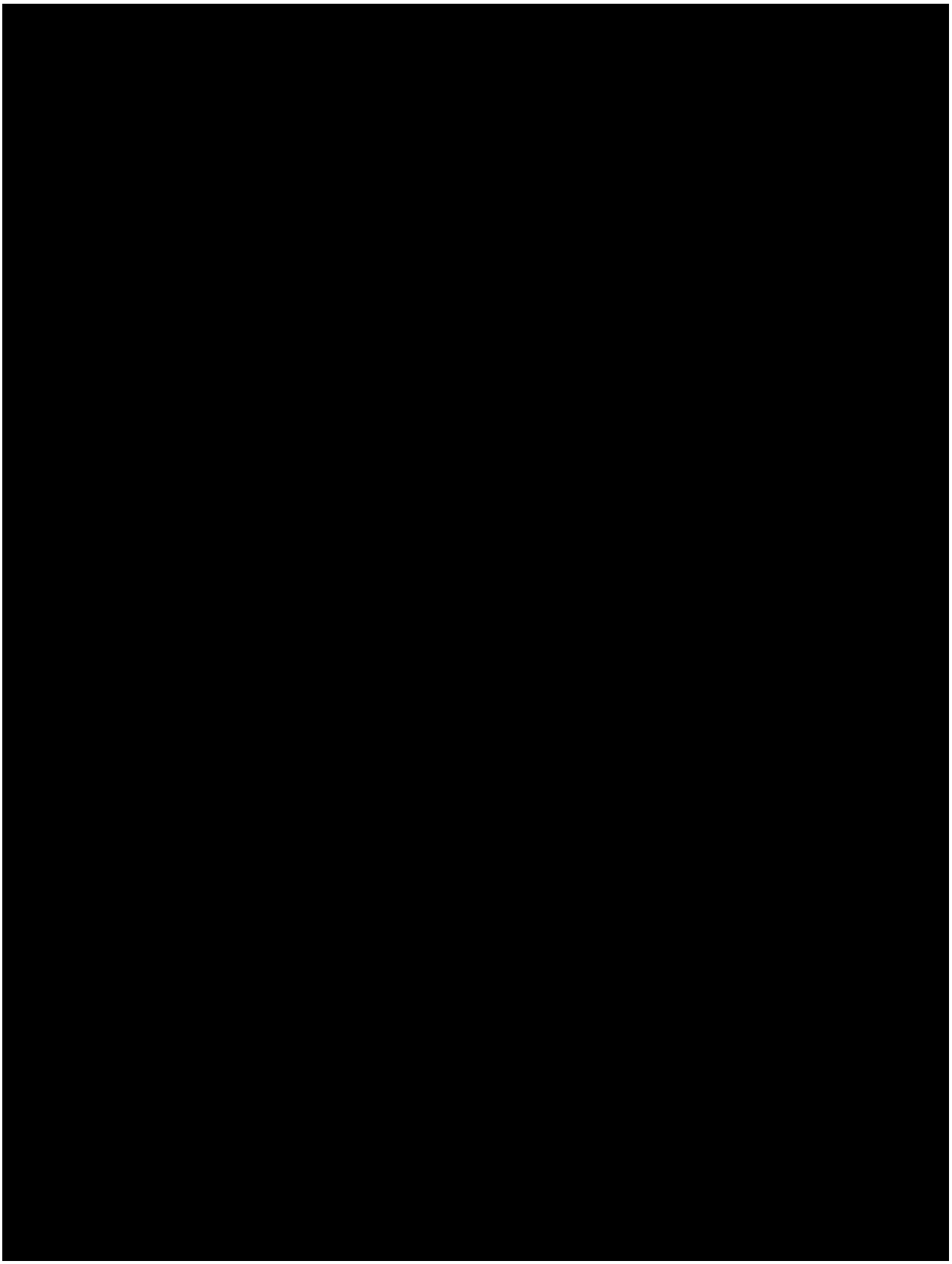

Figure 3-6 Basic Call Processing Peg Counts

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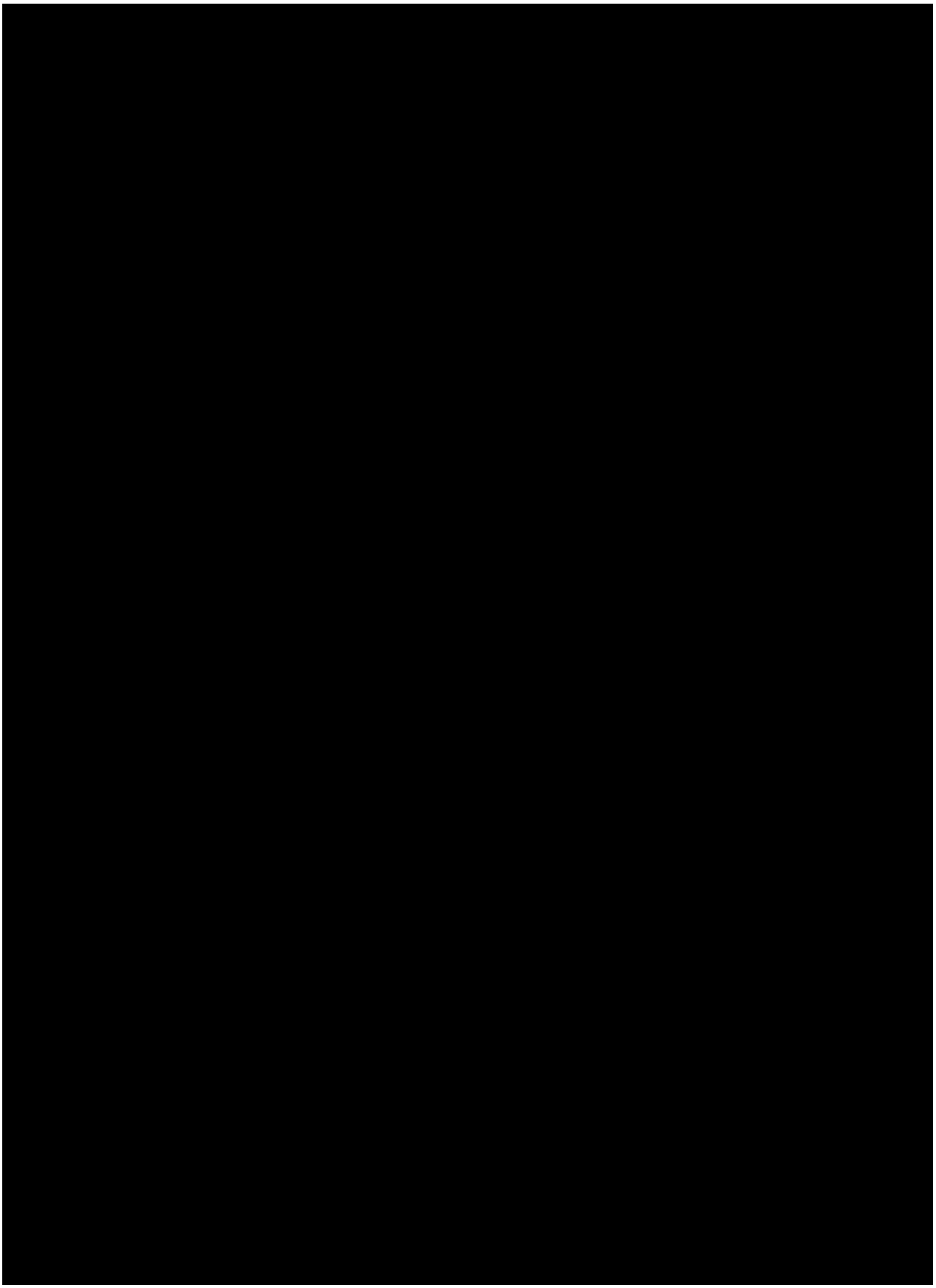

Figure 3-7 ISDN Call Processing Peg Counts

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4. MEMORY OVERVIEW

4.1 GENERAL

The *5ESS*® switch contains many processors distributed throughout its various modules. Each processor requires memory space to perform its function.

In the following description, the memory requirements are defined in several different terms. The definitions of these terms are as follows:

- ***Byte:*** The byte is the basic unit of storage, and it is composed of eight binary digits or bits.
- ***Kilobyte:*** A kilobyte is 1,024 bytes. This term is commonly written as "K" or "KB" following the number. An example would be 256 KB that is actually 262,144 bytes.
- ***Megabyte:*** A megabyte is 1,024 kilobytes. This term is often written as "M" or "MB" following the number. For example, 16 MB is actually 16,777,216 bytes of memory.
- ***Gigabyte:*** A gigabyte is 1,024 megabytes. This term is often written as "G" or "GB" following the number. For example, 16 GB is actually 17,179,869,184 bytes of memory.
- ***Page:*** A page of memory contains a specific number of bytes of contiguous physical memory. The size of the page is variable, but it is always a power of 2 from 256 bytes to 8,192 bytes.

4.2 MEMORY STRUCTURE

The AM, CMP and SM contain protected and unprotected memory areas. Programs and data in the protected areas are backed up on disk; programs and data located in the unprotected areas are not. The protected memory is subdivided into static and text areas. The unprotected memory portion is also called dynamic memory. These memory areas are illustrated in Figure 4-1 .

The static and dynamic areas of memory make up the *5ESS*® switch data base. This is a relational data base that is distributed among the various modules making up the switch. Data may reside on all processors (AM, CMP, and SM) individually, redundantly, or partitioned among the various processors. Initial memory sizing assumes an even distribution of data in a community of *5ESS*® switch equipment. These communities are defined as groups of SMs with similar hardware and feature characteristics.

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Figure 4-1 Protected and Unprotected Memory Areas

4.2.1 STATIC MEMORY

Static memory (or static office dependent data) contains information that describes the equipage and feature characteristics of a particular telephone office. Static data is also called static office dependent data (SODD). Static data changes infrequently, and the initial contents of the static ODD are provided to the *5ESS*® switch through the office data assembler (ODA) facilities. The static ODD data can then be changed only through Recent Change (RC) or Customer - Originated Recent Change (CORC). Static data resides in the SM, AM and CMP, and is backed up on disk. The static memory area has the following actual and physical limits.

Actual Limit: This is the limiting point of the memory allocated for use in the AM, CMP, or SM.

Physical Limit: This is the total amount of memory equipped in the AM CMP, or SM. Additional memory may be equipped through the addition of memory boards. Each SM processor has a limit for the amount of memory that may be addressed. Refer to Section 10.1 , "Switching Module Processor," in Section 10 , "SM RESOURCE UTILIZATION."

Static memory is provided in this manner to improve the packing of memory as well as minimizing the amount of data that must be backed up on disk.

Static memory is growable within certain limits. Refer to Section 10 for the individual processors for this information and *5ESS*® Switch Digital Ordering and Planning System (DOPSMOD) for engineering. Additionally, an in-service monitoring procedure (also described later in this section) is available to monitor memory usage.

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4.2.2 DYNAMIC MEMORY

Dynamic memory (or dynamic office dependent data) consists of equipment status, call status, work queues, etc. Dynamic ODD is initialized by various processes at initialization. The data is generated by programs such as call processing programs and typically includes information read from static data. Dynamic ODD changes frequently, and is changed mostly by the call processing and other related programs. It is affected by RC (for example, through the addition of new multiline hunt groups, etc.).

Some dynamic ODD is created when a process (usually a terminal process) is created and exists only for the life of the process. Other dynamic ODD exists from one initialization (bootstrap) to the next. It is re-created on each initialization. Since this data resides in unprotected areas of memory, software application programs provide direct access to this data and may change the data as often as necessary. These changes can occur many times during the duration of a telephone call. Dynamic data is not backed up on disk but may be recovered through a system of audits and reinitializations from static data.

The amount of memory space provided for dynamic memory in the AM is fixed by the software release and is not growable except by Lucent Technologies. These space allocations are engineerable and field adjustable. A portion of this dynamic memory is for dynamic ODD. The amounts of AM, CMP and SM dynamic ODD available in each software release are provided in the descriptions of AM, CMP and SM memory.

4.3 MEMORY INPUTS

There are several inputs required to perform memory management, planning, engineering and administration activities. These are:

- **Memory Concepts** include knowledge of switch architecture (hardware) and software as it pertains to memory.
- **Guidelines/Rules/Requirements/Limits** are rules of the road for memory that are provided in the Memory SEIs, and 235 series of documents.
- **Feature** use and penetration that impacts the consumption of memory.
- **Applications** implemented that will impact memory, e.g., unbundling, Long Distance Platform.
- **Philosophy/Policy/Procedures** pertain to memory that the switch owners have instituted
- **Office Environment/Dynamics** regarding incumbent and competitive LECs and office growth.
- **Tools/Commands** that the *5ESS*® switch provides to monitor and perform memory related activities.

4.4 MEMORY HARDWARE

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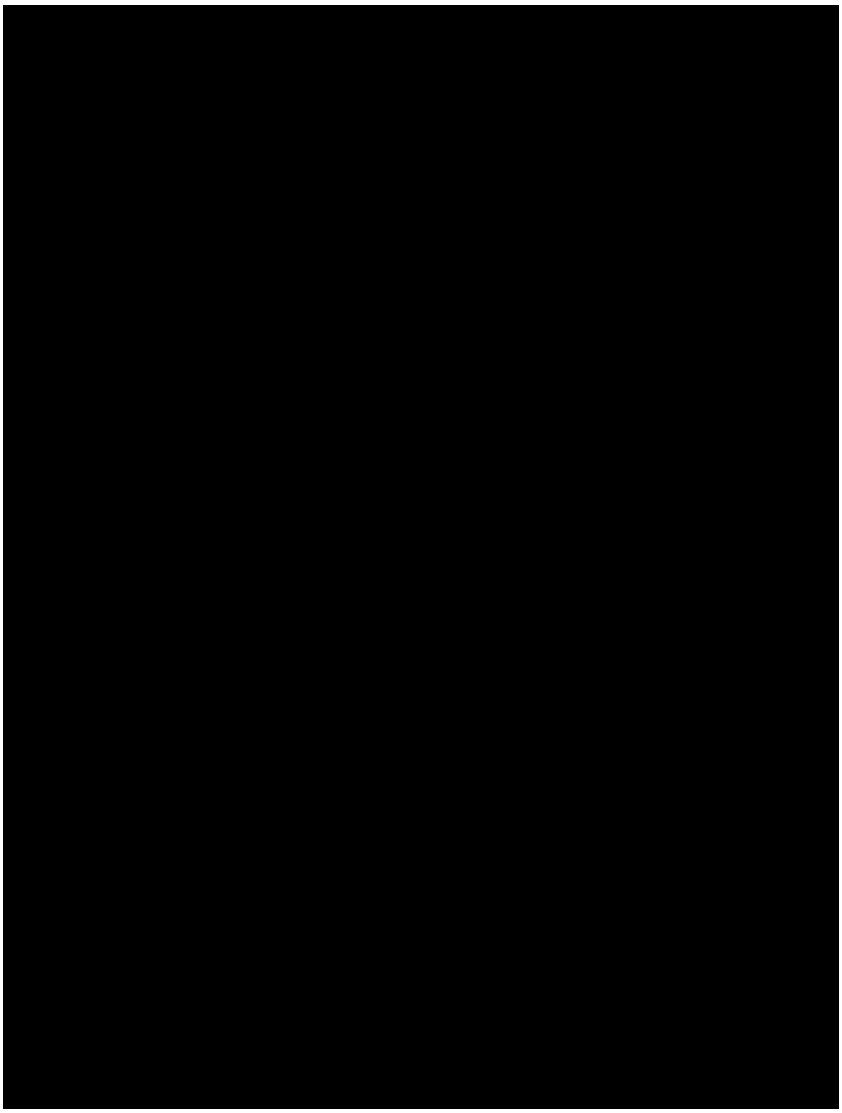

Figure 4-2 5ESS Switching System

Figure 4-2 shows an overview of the memory locations located on the *5ESS*® switch. The *5ESS*® switch requires various memory configurations due to a distributed process within the switching system. Memory within the *5ESS*® switch is commonly fixed by software release or model type and, therefore is not engineered. The equipment that is required to be engineered are as follows:

- Main Store (MAS) located in the AM
- Disks located in the AM
- Switching Module Processor in the SM.

NOTE: The processor in the Communications Module Processor uses memory based on a software release and is not required to be engineered under normal circumstances.

4.5 MEMORY TYPES

This section describes the two types of memory and provides the information needed to monitor and administer the usage. The information provided applies to all software releases. Throughout the following paragraphs, the term "memory," unless otherwise specified, applies to random access memory (RAM).

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Generally, there are two types of memory that are engineered and monitored, Random Access Memory (RAM) and disk memory. The main processor memory, also referred to as MAS, is the RAM contained in the AM, CMP, and SM. Disk drive memory is the long-term memory storage attached to the AM.

4.5.1 RANDOM ACCESS MEMORY

The RAM is used to store high speed access programs and data in the MAS and SMPs.

4.5.2 DISK DRIVE MEMORY

The disk drive memory is used to provide backup of semi-permanent on-line data, less speed critical data, and Automatic Message Accounting (AMA) records and office images. The disk drives are associated with the AM and CMP, which requires that SM programs and data be transmitted via the CM to the SM.

4.6 ADMINISTRATIVE MODULE HARDWARE

The AM provides all administration and maintenance functions within the *5ESS*® switch and is mainly responsible for the following processes:

- Fault detection
- Fault recovery
- Diagnostics
- Administrative data processing
- Access to external data links
- Disk storage
- Signaling System 7 (SS7) call processing.

The AM is comprised of three major units; the Central Processor Unit (CPU), Disk File Controller (DFC), and Input/Output Processor (IOP).

The CPU is the central control in the AM and is responsible for the overall operations of the *5ESS*® switch. Located within the CPU, a subunit, the MAS is considered the main memory.

The DFC is the microprocessor controlled interface between the AM/CMP and the disk memory. It is responsible for accepting tasks from the AM/CMP and assigning each task to a disk drive queue.

The IOP functions as a front-end processor to control transfer between the main store of the AM processor and the various peripheral units. This reduces the load on the AM processor.

The two configurations that must be considered when engineering the AM are the following:

- 3B20D
- 3B21D.

4.6.1 3B20D PROCESSOR

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Figure 4-3 3B20D Physical Layout

Figure 4-3 displays the architecture of the 3B20D processor. The cabinets associated with the 3B20D processor are listed as follows:

- Processor Control Cabinet (PCCA)
- Tape/Disk Cabinet
- Optional Cabinets.

The PCCA contains two cabinets with the 3B20D Computer and are as follows:

- The tape/disk cabinet contains the tape unit and disk drives.
- The optional cabinets are a second tape cabinet or a disk cabinet.

4.6.2 3B21D PROCESSOR

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Figure 4-4 3B21D Physical Layout

Figure 4-4 displays the physical architecture of the 3B21D processor. The cabinets associated with the 3B21D processor are the peripheral growth cabinet, which contains the nine track SCSI tape unit, and the processor cabinet that contains both, 0 and 1, sides of the AM.

The 3B20D and 3B21D processors are similar in function, with the exception of the following differences:

- The 3B21D processor supports the SCSI tape, the Digital Audio Tape (DAT), and the 1 + gigabit SCSI disk drives.
- The 3B21D processor does not support the 340 , 322, and 600 MB disk drives or the Keystone and Kennedy tape drives.

4.7 SWITCHING MODULE HARDWARE

The Switching Module Processor provides system control over all peripheral units related to the SM. The SMP contains the microprocessor and controlling programs for the SM. The programs are stored in RAM and backup is provided on disk in the AM.

The processor and the memory comprise the main parts of the SM. The SMP hardware has evolved to provide improved performance in the SM.

In order to determine the SM processor, the following implementations may be made:

- Make a physical visit to the office to examine circuit pack installed.
- Check the TRFC30 report Section 15 (5E9.2 and later) or Section 13 (5E9.1) for percent occupancy between the midnight to six a.m. (no-load condition) time frame.

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- Examine Telephone Equipment Order(s) (TEO).
- Utilize the flow chart in the 235-106-102, Software Release Retrofit Procedures document.
- Access RC view 18.1 Screen 1 and proceed per targeted SM from OP:MEMSIZE to read Item 3 (Unit Type). Proceed to item 15. If item 15 has three digits that being with a four or six, an SMP12 is present. Note that an SMP23 would have six digits that begin with a four.

4.7.1 COMMUNICATION MODULE HARDWARE

The CM is responsible for the switching of data time slot messages between SMs, switching control of time slot messages between the AM, CM, and SM processors, and provides system synchronization and quick pump of SM memory capabilities.

The CM is composed of one to six pairs of cabinets, depending on the number of SM/SM-2000s in the office. A full set of six pairs of cabinets have the capability of supporting a maximum number of 192 SMs, including RSMs. This number varies with the SM-2000s.

The initial pair of cabinets, cabinets 05 and 06, contain the following components:

- The Message Switch (MSGS):
  - A CMP unit
  - A Message Switch Peripheral Unit (MSPU)
  - A Message Switch Control Unit (MSCU).
- The Time Multiplexed Switch (TMS):
  - A Time Multiplexed Switch Unit (TMSU)
  - A Communication Module Control Unit (CMCU)
  - A second TMSU.

NOTE: **A second TMSU is present when the dual fabric or single fabric in an office contains more than 165 SM/SM-2000s.**

Cabinets 04 and 07 include the MSPU, which contains one or two TMSUs, a Emitter Coupled Logic Bus Units located on the MSCU and CMCU, and a (6-fan) Fan Unit in each CM cabinet. The number of pairs of cabinets is dependent on the number of NCT/NCT2 links required to be terminated from SM/SM-2000s.

4.8 MEMORY SOFTWARE OVERVIEW

This section presents the memory related software regarding the 5ESS switch.

4.9 MEMORY PLANNING AND MANAGEMENT TRIGGERS

There are several events that often require attention to memory, and should always be considered as indicators that new or reengineered memory may be required. These are:

- **New Start or Office Engineering** Memory planning is required for a new office. New switches come with enough physical memory to meet the requirements of the installed software release that comes with the new switch

- **Retrofits** Memory equipage is dependent on the software release program. If the software release program changes, there may, and usually will be, an impact on the amount of memory required in the AM, CMP, SM, SM-2000, and possibly the Disk.

- **Feature Growth** If features are added to the *5ESS*® switch, it may be necessary to allocate more Static ODD memory or to grow additional memory. A feature can be defined as an enhancement to basic telephone service (e.g., Speed Calling or Call Forwarding).

- **Hardware Growth** If hardware is added to the *5ESS*® switch, it may be necessary to add new memory. Examples are the addition of a new SM-2000 to an office, or additional peripheral images.

- **New Applications** If a switch must support new applications such as switch unbundling, memory may be impacted.

- **Output Messages** Output messages may indicate the need to grow memory. If, for example, ODD "MEMORY USED", conveyed through the OP:ODD command readout, is beyond a certain percentage, the administrator may wish to allocate more memory to the ODD.

- **Alarms** Minor alarms are engaged when OP:ODD "MEMORY USED" reaches 80, 85, and 90%. Major alarms are engaged when "MEMORY USED" reaches 95, 96, 97, 98, 99, and 100%.

Ideally, memory is provided based on the requirements for an office when the next growth is required. This is referred to as End-of-Period (EOP) engineering. However, in today's environment on-going memory monitoring is recommended due to the growth in features (particularly those with substantial memory impacts) and new applications.

4.10 DATA BASE AND PROGRAM DISTRIBUTION

The office data base and programs are located in the AM and CMP, and in individual SMs. Software is stored on processors (AM, CMP, and SM) individually, redundantly, or partitioned among the various processors. The data base in each SM contains all the information related to both customer lines and trunks that terminate on the particular SM. Tables of data that apply to functions done in the AM are located only in the AM. The general distribution of the *5ESS*® Switch database is shown in figure 4-5 .

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Figure 4-5 Data Distribution

4.11 OFFICE DEPENDENT DATA

The ODD is that portion of the data unique to a *5ESS*® switch. This includes the static data (translations, parameters, etc.) and dynamic data (equipment and line status, work queues, etc). The size of the ODD data base is dependent on the number of lines, trunks, equipment, etc., and the amount and types of features provided. Additionally, the ODD memory space may be grown and allocated as necessary to support equipment and features required. Sizing of the ODD data base is done during the engineering and ODA processes. It may be done after turnover to determine the impact of line and/or feature and hardware growth.

The data required to build the *5ESS*® switch office data base originates from two major sources: the switch owner (or the owner's designated switch manager) and the Lucent Technologies line engineer.

The switch owner is responsible for entering all information associated with the call processing function of the *5ESS*® switch. This data (or translations) comes from various forms that are completed by the switch owner.

NOTE: These translation forms are part of the *5ESS*® Translations Guide (TG5). Examples of translations provided by the switch owners are: lines and trunks, routing and charging, equal access, Business and Residence Custom Services (BRCS), etc.

The Lucent line engineer is responsible for "building" the hardware data (parameters) based on the switch owner's requirements from the equipment order. Other major responsibilities include:

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- Establish the office registration
- Determine the translations start date
- Perform the data base validation
- Enter hardware equipment locations (parameters).

NOTE: As an option to the switch owner, Lucent Technologies may be responsible for all data entry. In this case, the switch owner will normally be requested to provide a magnetic tape with the data and Lucent will have responsibility for entering all this data.

4.12 INITIAL DATA BASE (VIA 5 ODA)

The *5ESS*® switch Office Data Assembler (5 ODA) is a software system developed by Lucent Technologies. The initial office data base is built through this system. The 5 ODA system allows both the switch owner and the line engineer to enter the data through a dial-up access after the office has been registered.

Following the entry, the line engineer performs data validation and, if necessary, notifies the switch owner of any errors. The switch owner is responsible for making corrections. Office records are also produced by the 5 ODA system, both during and after data entry.

When data entry is completed the following occurs:

- The line engineer requests 5 ODA to produce an ODD tape
- The ODD tape is then used to load the *5ESS*® switch office data base.

An overview of *5ESS* ® switch data generation responsibilities is depicted in Figure 4-6 .

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Figure 4-6 Data Generation Responsibilities

4.13 ODD DATA BASE

The ODD data base is based on a relational data base model. The word ***relation*** is the mathematical term for structures that may be thought of as tables. The data base is considered as a collection of relations. The relations are stored in fixed-length areas of memory called ***pages***. The relation is a 2-dimensional table of related data. An illustration of a relation is given in Figure 4-7 .

Each data table is called a ***relation***, and each row of a relation is called a ***tuple***. The entries in a row (the columns) are called ***attributes***. To provide access to specific tuples, one or more attributes are designated as the ***key*** for the relation. This means that not more than one tuple with the same key exists in the relation. When specific tuples are to be accessed, the key must be given that will identify a unique tuple in the relation. A key may consist of more than one attribute and, here, all attributes of the key must be provided to access the tuple.

A relation can have only one key. However, as previously described, more than one attribute may be used

to represent the key. If a tuple must be accessed by the value of some nonkey attribute, then all tuples must be compared until the desired tuple is found. The set of allowable values that an attribute may have is called the ***domain*** of the attribute.

NOTE: The hypothetical relation given in the following example is intended to assist in the understanding of the relation concept. It is not intended to represent any actual data base relation within the *5ESS*® switch.

As an example, a directory number might be the key to a relation containing line information. Contained in this relation could be certain information (attributes) related to the features and privileges associated with the directory number. These features could include touch-tone capability, call waiting, call forwarding, speed calling, etc.

The key for this relation is the telephone number which is made up of the office code attribute and the 4-digit telephone number attribute. Therefore, the key must be a 7- or 10- digit number having only certain values. The office code is limited to only the particular codes available in the office, and the telephone number could range from 0000 to 9999. These allowable values represent the domain of the attribute. For the features and privileges allowed for the line, the tuple could contain a "yes" or "no" value for each one. This represents the domain of those attributes. Further, the telephone number could not be represented by a "yes" or "no" value, because it is not in the domain of that attribute. Likewise, the feature privileges attribute could not contain a 7- or 10- digit number.

Figure 4-7 A Data Relation

4.13.1 DATA ACCESS

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When a program needs a specific piece of information (a tuple within a relation), the relation name and the key attribute for the desired tuple are provided to the data base manager (DBM). The DBM then locates a set of information about that relation in data ***dictionaries***. These dictionaries provide information such as access-type, relation and attribute identifications, number of subattributes, domain identifications, etc. With this information, the DBM can identify the head table for the relation that, among other things, identifies each data page associated with the relation. Finally, using the key attribute and the access type, the DBM can locate the desired tuple on a data page.

Figure 4-8 is an example of the way several relations interact. In this example, the Port ID (a converted line equipment number) is a key attribute and it relates to the telephone number (TN). The TN, in turn, is the key attribute to a relation that specifies how call processing is to treat this call. Another relation uses the line class code (LCC) as a key attribute and defines other attributes associated with it.

Figure 4-8 Relation Interaction

Four different methods are automatically used by the *5ESS*® switch to store and access information in the data base relations. These access methods are: sequential, indexed, hashed, and compacted indexed. The different methods are necessary to provide the most efficient access to data in the various sized relations. The access methods are described in the following paragraphs.

4.13.1.1 Sequential Access

The sequential access method (used for short lists) uses a head page and several data pages to contain the necessary information. When a particular tuple is desired, the DBM locates the appropriate head table, which provides the location of the data pages for the relation. The keys on these data pages must then be read sequentially, from top to bottom, until the desired information is located. Figure 4-9 depicts an example of a relation that is accessed sequentially in the office code relation.

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Figure 4-9 Sequential Data Access

4.13.1.2 Indexed Access

For the indexed access method, the key is divided by a power of two. The quotient points to the position on the head page that provides the address of the data page containing the desired tuple. The remainder points to the position on the data page where the tuple resides. This method is used in cases where the number of tuples stored is relatively large. The indexed access method is shown in Figure 4-10 . The indexed access method is used only for dynamic data relations. An example of an indexed dynamic relation is the trunk status relation.

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Figure 4-10 Indexed Data Access

4.13.1.3 Hashed Relations Access

The hashed relations use one head page and several data pages that are divided into primary and secondary pages. During RC operations, the size of the relations often needs to be changed to accept additional data. The new data must be stored in such a way that the key can be used by the DBM to locate the data. A mathematical operation is done on the key to obtain a new key called a folded or hashed key. The folded key is treated as in the indexed method (except that the division is not necessarily a power of two). This operation provides two pointers. The first pointer is used to index into the head page to obtain a pointer to the primary page, and the second points to the position on the primary page. Since the folding operation for different keys may result in the same folded keys, and hence the same pointers, the desired information may not be selected directly. The key resides with the tuple and is compared to the key that was used to initiate the search. If the keys match, then the desired data has been located. If the desired tuple is not found at the selected location in the primary page, then up to three more tuples are read in sequence from the primary page. If the desired data is still not located, then the four primary overflow tuples at the end of the primary page are read sequentially. If the desired tuple is still not found, then the DBM must access the secondary overflow page and read it sequentially. An example of a hashed relation is the speed call list relations. The hashed method is illustrated in Figure 4-11 .

The hashed relations are the ones of primary interest to the administrator. During periods of heavy RC activity, these relations may require some secondary overflow. More processor time is required to search

the overflow pages for data to do the necessary call processing functions. Also, more time is required to enter the RC data. A memory reorg (reorganization) is required to repack the primary data pages and to release the secondary pages for future use. Additional memory space must be available to do the reorg operation. The space available for reorg should be about 50 percent larger than the largest hashed relation.

Memory reorgs may be allowed to occur automatically at a specified time each day. If this is allowed, the reorg occurs only at that specified time. All relations in this condition (secondary overflow) are then reorged. Also, a reorg may be requested to occur at any time; note that the reorg will not occur unless it is "allowed." Therefore, it may be necessary to first enter the command to allow the reorg, and then request the immediate reorg operation. The procedures required to do the reorg functions are provided in 235-105-220 - *Corrective Maintenance Procedures*. This manual also contains information concerning data base maintenance and repair.

Figure 4-11 Hashed Data Access

4.13.1.4 Compacted Index Access

A compacted index data access method is employed for certain static relations that previously used the hashed access method (i.e., digit analysis and screening translations). The compacted index method may use one, two, or three levels of indexing allowing a key of up to 32 bits in length (in the 3-level method) as compared to the 16-bit key for the 2-level access method. This allows indexing on larger relations instead

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of using the hashed method. Additionally, data can be accessed much faster since secondary overflow pages are not required. Therefore, less memory space is required for reorg.

With the compacted index method, the key can be used to index into 1-, 2-, or 3-level relations, as determined by the size requirements for the relation. For 1-level relations, the key points directly to the position in the memory page where the desired tuple resides.

For 2-level relations, the key may be divided by a power of two. The quotient and remainder are used as pointers to the data page and desired tuple as described for the indexed method. For some relations, the key may be divided by the tuple length (which is not a power of 2) to obtain the two pointers. Since the key represents a direct pointer to the desired tuple, it is not necessary to store a duplicate of the key with the tuple for comparison as is required with the hashed index method. This provides an additional memory space savings. Sometimes the size of the relation will not be less if the key is not stored and, in these cases, the key may be stored.

The 3-level compacted index method is like the 2-level method except that an extra division step is done. The first-division step locates the tuple in an intermediate data page that contains the address of the final data page. The second-division step provides a pointer to the position in the final data page that contains the desired tuple. The 3-level compacted index method is used only for static relations and is shown in Figure 4-12

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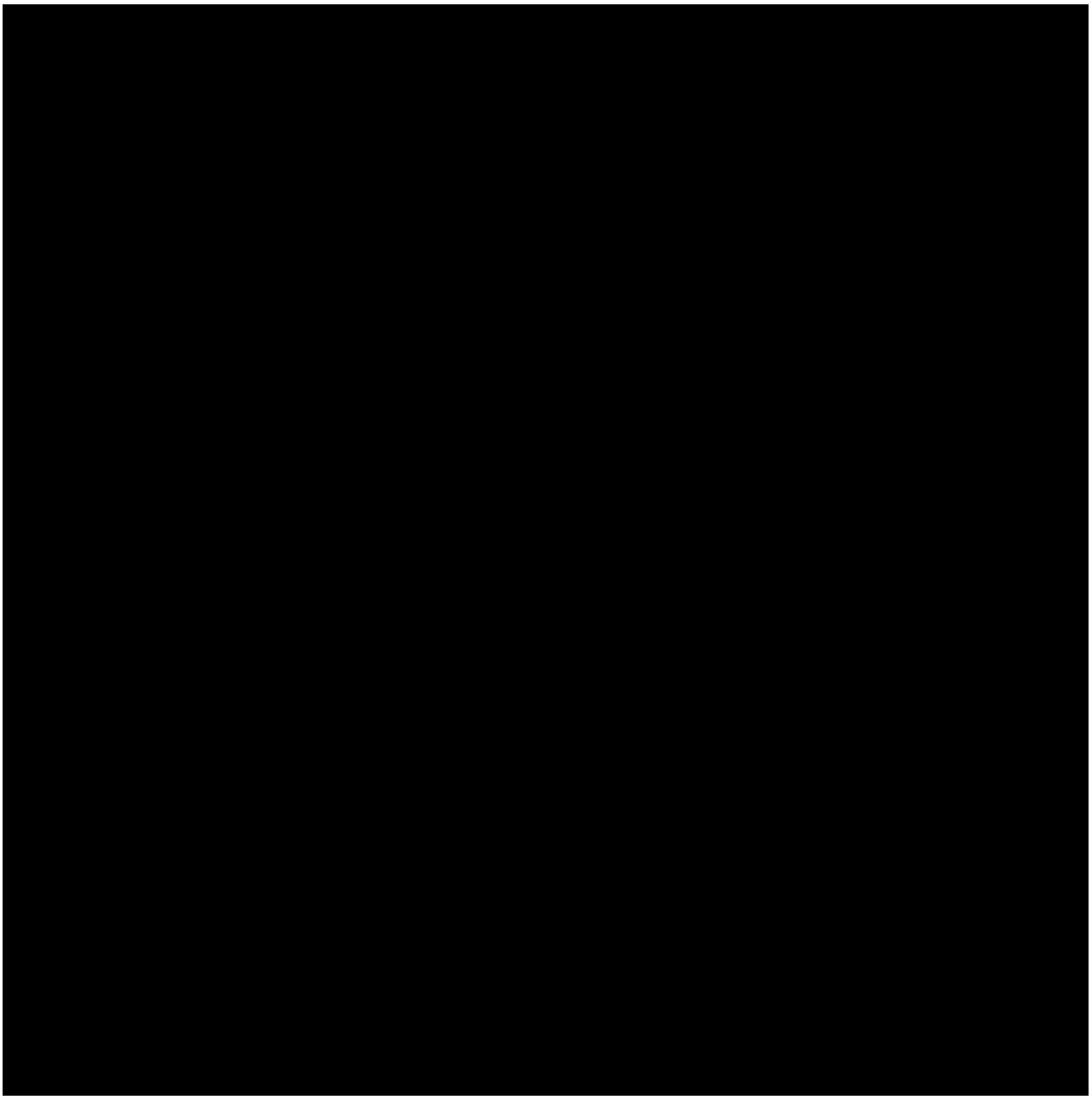

Figure 4-12 Compacted Index Data Access.

4.13.1.5 Data Base Reorganization Enhancements

The data-base reorganization enhancements feature incorporates a new hashing algorithm and new overflow strategy into the data-base manager. It also uses an existing off-line data base hashing simulator tool (HSHIM) to enhance data base reorganization. The simulator is used when manual reorganization is necessary and provides a memory checking mechanism to determine if a growth needs to be performed before a reorganization can proceed.

4.13.1.5.1 Operational Views for ODD and Memory Optimization

The Operational View capability decouples the "static" ODD storage format in every processor (AM, SM, and CMP) from the user's [RC/V, office data administration (ODA), other *5ESS*® switch application code] operational/conceptual view of data. Decoupling the storage format from the user's operational view of the data (virtual tuples) achieves something similar to normalization for some of the existing relations by

splitting up virtual tuples into two or more groups of attributes. Each group of attributes is physically stored in other relations called storage relations. All storage relations are accessible only by internal Data Base Manager (DBM) code.

The operational view access method (DBACC_OPV) translates a primitive operation on a virtual relation into an ordered sequence of operations on the storage relations that make up the virtual relation. Virtual relation tuples do not have a corresponding physical tuple stored in the ODD. A virtual relation can be represented using a tree diagram, where each node represents a storage relation. All the primitives invoked on the virtual relation traverse the tree.

4.13.1.5.2 Generated Key Access Method

An access method in a software release is the generated key access method (DBACC_GK) that optimizes both read access time and memory utilization. The DBACC_GK access method assigns (or generates) a key whenever a unique tuple is inserted. The generated key (GK) value for a tuple is determined by finding the first unused tuple slot in the relation. If an insert of a tuple with the same data content as an already existing GK tuple occurs, a new key is not generated for the second tuple. Instead the DBM returns the GK of the original tuple. The fast access time is achieved by using the compacted index access method for reading GK tuples.

4.13.1.5.3 Storage Relations

In addition to the virtual relation, a physical relation exists in a software release. Physical relations are defined as having physical tuples stored in the ODD matching the user-defined structure in the global header relation definition file.

Another type of physical relation called storage relations, is added by this feature and uses the relation type of DBSTORAGE. Storage relations are only known and manipulated by the DBM code in support of virtual relations. Storage relations are the only relation type that can take advantage of the new generated key access method in addition to the existing access methods. There are two logical types of storage relations:

- Root Storage Relations - have the same key as the corresponding virtual relation. A root storage relation is at the top of the virtual relation tree. Therefore, Root Storage does not have any parent nodes. However, the root storage relation contains the key information (a generated key) necessary to access its one or more child storage relations.

- Child Storage Relations - are accessed either by generated key or by a foreign key (in the case of Read Only and Read Only with Batch Review Inhibited).

A generated key (GK) is an attribute whose value is generated by the DBM to facilitate efficient storage of that relation's tuples. The value of a GK is determined by the position chosen for its storage in the relation. The GK for a generated key child is stored in its required parent relation's tuple. A GK relation can have multiple parent storage relations whose tuples may point or share the same GK child tuple. A child storage relation keyed using generated keys cannot be a root relation because root relations must have the same key as its virtual relation, but it can store the generated keys of 0, or more GK storage relations as its children.

A foreign key is defined as an attribute or set of attributes stored in one or more parent storage relations that uniquely define the primary key of a child storage relation tuple. The term foreign indicates that the key is located within a separate or foreign storage relation. In addition to only being allowed in read only types of relations, foreign keys are different from generated keys in that they are user defined values that are not system generated.

4.13.2 SM/SM-2000 MEMORY

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4.13.3 CM MEMORY

4.14 MEMORY MANAGEMENT

Memory management in the *5ESS*® switch involves monitoring the memory requirements for the AM, CMP, SM/RSM, and disk drives to insure that the requirements do not exceed the equipped capacities. In the AM, CMP and SM, it is important to monitor the ODD requirements. For disk drives, it is important to monitor the total ODD requirements for all SMs and RSMs and the AMA billing data space requirements. The total disk space requirements should be compared to the space provided by the disk configuration employed and the total number of disk drives (base and optional).

Memory management involves knowing how much memory is equipped in the AM, CMP, and SMs/RSMs. This can be determined by examining the telephone equipment order (TEO), by actually looking at the circuit packs installed in the cabinets, by RC Views 18.1 and 18.4, and the OP:MEMSIZE command output. It is also important to know how much of the equipped memory is allocated and, further, how much of the allocated memory is used. This is determined by using the OP:ODD input message. All memory requires monitoring on a regular basis, especially in dynamic offices (e.g., line growth, new features etc.). Additional details, about memory management for the AM, CMP, SM/RSM and disks, are found elsewhere in these guidelines. Further details concerning the use of the OP:ODD message and the resulting output message can be found in *Input Message Manual*, 235-600-700 and *Output Message Manual*, 235-600-750, respectively.

Memory in the *5ESS* ® switch is allocated in one of seven block sizes: 128, 256, 512, 1,024, 2,048, 4,096, and 8,192 bytes. The status of these memory blocks (busy or available) is continually changing in the switch. A memory status map maintained in the switch is used to continually monitor the status of the memory blocks. This bit map contains memory status information for each 256-byte block of equipped memory. This minimizes the search for a memory block in any of the defined block sizes.

Initially, memory searches are done for the exact size of the block needed. If the block cannot be located, the next larger sized memory block is selected. When this occurs, the unused portion of the memory block remains in the status map as available. If a free memory block cannot be found, the appropriate output messages are printed, and a growth function may need to be invoked by the maintenance personnel. This function moves the actual memory limit so that an additional block is available. The procedures for memory growth operations can be found in 235-105-23X, *Hardware Change Procedures*. The procedures for allocating memory can be found in 235-105-210,*Routine Operations and Maintenance*.

Periodic audits are done to ensure that blocks of memory are not lost. These audits establish a new audit bit map that is compared to the original map to locate and correct any discrepancies.

At some time, it may be necessary to change information contained in the data base. An office data base editor (ODBE) is provided to allow this type of change to be done. These changes should be coordinated with the maintenance personnel as this editor has no error checking, and mistakes can be extremely disruptive.

4.15 ASSOCIATED MEASUREMENTS AND KEY SERVICE INDICATORS

There are no plant or traffic measurements for memory usage. The OP:ODD command provides the means for determining how static memory is being used. This command, entered from the master control center (MCC) or the Switching Control Center System (SCCS), provides the following information for the AM, CMP, and SM memory:

- The amount of memory space used.
- The amount of memory space allocated.
- The amount of SM memory space unallocated.

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- The percent of allocated memory space used.
- The amount of stand-alone billing space allocated.
- The amount of Real Time Billing memory allocated.

Refer to the *Output Message Manual*, 235-600-750 for the format of the OPP:ODD output message. The amount of static memory required for ODD space increases due to recent changes (new lines, feature assignments, etc.); therefore, it is necessary to monitor the utilization of this memory. The output of the OP:ODD command may be used to monitor the use of static memory. In addition to the manual use of this command, automatic reports and alarms are generated when certain memory utilization thresholds for AM, CMP, SM, or disk are exceeded. Minor alarms are provided when static memory usage exceeds 80, 85, and 90 percent of the allocated space. Major alarms are generated when usage reaches 95, 96, 97, 98, 99, and 100 percent. To conserve disk backup space, allocated memory is often less than the amount of physically equipped memory that may be made available.

For further details about the use of the OP:ODD command and the resulting output messages, refer to *Input Message Manual* , 235-600-700 and *Output Message Manual*, 235-600-750.

4.16 TRANSITION IMPACT

Memory is engineered to be adequate at the end of the engineering period. Memory adjustments may be required for retrofits to new software release to support feature or hardware growth.

Growth procedures can have a significant impact on SM memory. Adding lines, features, trunks, RSMs, etc., will require additional memory space for ODD.

Increases in the allocated ODD space within the SM memory can be done through craft commands. Physical memory growth may be done using growth and RC procedures. For more information about these procedures, refer to the 235-118-XXX *Recent Change Procedures*.

Certain memory items are used to determine the utilization of memory. In some cases, these items are measured in different sized blocks that are identified as follows:

- GLPMEM_SZE is the term used in parameters to provide the total amount of ***equipped*** memory in an SM or RSM. It is provided in terms of the number of 1K-byte blocks available.
- DBPHYSBLKS is another parameter that is measured in 256-byte blocks. This parameter represents the amount of ***allocated*** memory in the SM or RSM.
- The number of growth blocks available is measured in terms of 1K-byte blocks.
- The output of OP:ODD is in terms of kilobytes of memory.

4.16.1 OP:ODD COMMAND

The static ODD is separated into redundant and nonredundant ODD. The nonredundant ODD contains all information specific to a particular SM (such as features assigned and characteristics of lines and trunks served by that SM). The redundant ODD contains information that is the same on every SM such as routing information, and division of revenue data. Additionally, the unprotected ODD (dynamic ODD) is now contiguous to the nonredundant ODD. The redundant and nonredundant ODD, as well as the stand-alone billing memory (the section of memory dedicated to AMA data), continue to reside at the end of memory. See Figure 4-13 .

For each of the following allocated ODDs, OP:ODD report prints the used memory and available memory, in K-bytes and the percentage of memory currently used:

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- AM SODD (AM static ODD) - growable but requires rebooting
- AM UODD (AM dynamic ODD) - not growable
- AM DISK (AM disk ODD) - not growable
- SM RODD (SM redundant ODD) - growable
- SM NRODD (SM nonredundant ODD) - growable
- SM UODD (SM dynamic ODD) - growable
- SM SAB (Stand Alone Billing)- growable
- SM RTB (SM Real Time Billing)- growable
- CMP UODD (CMP dynamic ODD) - not growable
- CMP SODD (CMP static ODD) - not growable.

When the thresholds are met for the nongrowable memory areas, memory growth is required. When thresholds are exceeded for the growable areas of memory, additional memory may be allocated (assuming there is unallocated memory available).

The OP:ODD report also provides the size of unallocated and the stand-alone memory available. All memory sizes are reported in K-bytes. The unallocated section of memory resides at the end of SM memory and is available for ODD growth.

Text is base data that comprises the current, installed software release.

The SM UODD memory growth is done by moving the starting address of SM NRODD into higher memory. The ending address of NRODD remains unchanged. Because of this, the UODD growth is limited in size by the amount of space available in the NRODD. The SM UODD growth should be done only if necessary because the SM UODD is engineered to be adequate for most offices.

The NRODD growth increases the amount of memory allocated to the NRODD by shifting the entire RODD and stand-alone billing areas into higher memory.

Finally, the RODD growth operation moves all the stand-alone billing area into higher memory. Growth of RODD occurs simultaneously on every SM.

PO memory is allocated for code in text of only the peripheral units equipped on the SM. No memory is used for peripheral units not equipped.

RTB is a default allocation of memory for Real Time Billing that will be provided for every SM whether or not the Long Distance Platform, Real Time Call Detail feature is utilized.

Stand Alone Billing refers to memory space allocated for the storage of billing information when the SM/SM-2000 is in stand-alone mode.

The unallocated memory reported by OP:ODD is free for growth of NRODD or RODD. When the unallocated space has been used, no further RODD or NRODD growths can occur without memory hardware growth or a reduction of stand-alone memory area (if the feature is turned on) in an RSM. Degrowth of an RSM results in a shorter stand-alone billing period in the RSM, if the RSM is forced into stand-alone operation, and may, therefore, result in lost revenue. If the unallocated space (SAB not turned on, SAB degrown) is not enough to grow the SM NRODD or RODD, hardware memory growth is required. Detailed ODD growth procedures can be found in 235-105-210 - *Routine Operations and Maintenance*

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Procedures.

Figure 4-13 SM/RSM Memory Structure

4.17 MEMORY RELATED DOCUMENTATION

Table 4-1 shows Lucent Technologies information products that are available that contain information on some aspect of memory.

Table 4-1 Memory Related Documentation

AREA	DOCUMENT NUMBER	DOCUMENT NAME
General	235-100-200	*5ESS*^{TM} Switch Hardware Description
	235-190-400	*5ESS*^{TM} Switch Feature Description
	235-600-700 235-600-750	*5ESS*^{TM} Switch Input/Output Messages Manual
	235-080-100	*5ESS*^{TM} Switch Translation Guide TG-5
Procedural	235-106-xxx	*5ESS*^{TM} Switch Software Release Retrofit Procedures 5Exx
	235-105-210	*5ESS*^{TM} Switch Routine Operations and Maintenance Procedures

Remember You should always check on-line documentation or the NAES external web site at **https://support.lucent.com/cgi-bin/gx.cgi/AppLogic+dns.custrepos?bu_id=NAES** to see if any Engineering Information, or Switch Engineering Information bulletins have been issued that impact memory related hardware or software. Contact your Translation Switch Administration (TSA) or Enhanced Network Engineering Committee (ENEC) representatives for a NAES password.

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5. ADMINISTRATION AND ENGINEERING SUPPORT SUBSYSTEMS

5.1 Additional Information

For further information on the *5ESS*® switch administration and engineering support subsystems, please refer to the *235-600-750 Output Messages Manual*.

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6. ENGINEERING AND ADMINISTRATIVE CONSIDERATIONS

6.1 ENGINEERING METHODOLOGIES

The equipment for the *5ESS*® switch is provided using traditional traffic engineering practices; number of lines, number of trunks, and usage. Engineering methods follow the modular architecture of the system. Traffic parameters are used to determine the number of interface units required and unit quantities are used to define the office size in Switching Modules (SMs/SM-2000s). The number of SMs/SM-2000s then determines the engineering for the Communication Module (CM).

The basic building-block of the *5ESS*® switch is the SM/SM-2000. An SM may serve various numbers and types of interface units [i.e. Line Units (LUs), Trunk Units (TUs), Digital Carrier LU (DCLUs), etc.] up to its time-slot capacity of 512 time slots (8 time slot sets). The general algorithm for sizing a *5ESS*® switch and accommodating individual variabilities is as follows:

- Given the traffic characteristics, calculate the number of interface units required
- Given the interface units required, calculate the number of time slots required
- Given the number of time slots required, calculate the number of SMs/SM-2000s required.

Traffic engineers use traffic-sensitive measurements to determine the need for new equipment. This section describes general traffic concepts and provides details for different methodologies and engineering philosophies.

Most engineers in telephony are familiar with Time-Consistent Busy-Hour (TCBH) engineering methods. These methods include Average Busy Season (ABS), Ten High-Day (THD), and High-Day (HD) projections. This methodology has been in practice for many years and has benefits owing to its simplicity, widely understood concepts, and relatively small amounts of data collection required.

Traditionally, the TCBH engineering methodology has been used for central office equipment provisioning. In TCBH engineering, the traffic load offered to a component is assumed to be at the maximum during a fixed clock hour, called the TCBH, in each (week) day of the ABS. Thus, equipment provisioning is engineered based on the average TCBH load. Although TCBH engineering is widely used, it is considered to be inadequate for engineering offices that exhibit a Bouncing Busy-Hour (BBH) pattern or a noticeable day-to-day load variation.

In the mid-1970s, the Extreme Value Engineering (EVE) methodology emerged from Lucent Technologies Bell Laboratories and is the recommended way to engineer the *5ESS*® switch. The EVE method differs from the TCBH method in ways of procedures and philosophy. The EVE methodology is based on daily peak loads regardless of the time of occurrence, and accounts for the effects of the BBH and the day-to-day load variation. While in the TCBH methodology, provisioning of equipment is determined so that the average service meets a given standard. Unlike the TCBH philosophy, the EVE philosophy assumes that the average service is not the service seen by an individual customer. This customer may experience below average service based on the time at which the call is placed. Therefore, service criteria in the EVE method is formulated to ensure that an acceptable grade of service is provided to the customer a certain percent of the time. The service criteria in the EVE methodology stems from the Average Daily Peak (ADP) averages, and is apart from the traditional philosophy of average performance, in the busy hour, underlying the telephone traffic theory and engineering practices. The basic engineering calculations in the EVE methodology are Once-A-Month (OAM) and Expected Value High Day (EVHD). Both methods of calculation, OAM and EVHD, are statistical projections. A benefit of the EVE methodology is the elimination of the need for busy hour determinations. These determinations are considered to be expensive and time consuming.

The introductions of the distributed digital switch architecture and modular growth of new equipment are driving traffic engineers and switch administrators to reconsider the meaning of both service and traffic

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loading on this type of switching equipment. The EVE methodology is the preferred method for growth engineering, administration of existing switching equipment, and engineering and administration of new services, such as the Integrated Services Digital Network (ISDN). Understanding the ISDN traffic variability for voice and data is important to the traffic engineer and switch administrator because it allows the most efficient use of their switching equipment.

6.1.1 TIME-CONSISTENT BUSY HOUR

This document only addresses the basic ideas of the TCBH methodology because of its wide use and understanding over the years. The objective of traffic engineering is to determine the least amount of telephone equipment required to provide a given grade of service. The most common time unit used for measuring the grade of service is one hour. When a grade of service is met for the hour with the highest traffic load, then the grade of service is sufficient to meet any other hour during a day. Thus, only those hours that have the potential of being the busiest in a day are of interest in traffic engineering. For this description, ***hour*** refers to the 60 consecutive minutes starting at a clock hour, ***week*** refers to the 5 working days, and ***month*** refers to a service observing month, which may or may not be a calendar month. The hours that the daily peak loads usually occur are called Candidate Busy Hours (CBHs). It is assumed that the CBHs in each day are fixed, and the number of CBHs identifies an office parameter.

The three highest traffic months in terms of average traffic load per CBH per Network Access Line (NAL), which may or may not be consecutive months, are referred to as the ABS or simply the Busy Season (BS). Among the CBHs, the hour having the highest average traffic load during the BS is designated as one of the following:

- Average Busy Season Busy Hour (ABSBH)
- TCBH
- Busy Hour (BH).

The BS data excludes Mother's Day, Christmas, and other extremely high traffic days that may be attributed to severe weather or catastrophic events that are not reasonably expected to recur from year to year. The BH traffic load averaged across the BS is referred to as the ABSBH load.

The ten busiest days during ABS in terms of the observed TCBH load are called the THDs. The average traffic load in the TCBHs of the THDs is called the ten high-day busy hour (THDBH) load. The one day among the THDs that has the highest traffic during the TCBH is designated the HD. The traffic level in the BH of the HD is termed the high-day busy-hour (HDBH) load.

According to the time frame used, there are three methods of engineering available in TCBH and are as follows:

- ABS or ABSBH engineering
- THD or THDBH engineering
- HD or HDBH engineering.

The traffic loads commonly used for engineering are ABSBH, THDBH, and HDBH loads. In general, ABS engineering is used for components with a low to moderate usage rate; HD engineering or THD engineering is used for components sensitive to traffic peaks.

Generally, there are two types of service criteria, blocking and delay. The service level of these two criteria are expressed by the following:

- The percent of demands for service that fail to receive service

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- The percent of demands for service that are delayed, or the length of delay.

Given the traffic load and the service level, the provisioning of equipment may be engineered using one of many available traffic capacity models (for example, Erlang B, Poisson).

Traffic data for TCBH engineering is collected on various units at a single consistent BH (for example, 9 to 10 a.m.) over time. When administering the data collection, an important process is the determination of the office BH for each unit type. This BH determination requires a study of all hours, or a set of candidate BHs, in the office for the various unit types. Some unit types may have BHs different than others. In practice, a single office BH may not be sufficient, therefore requiring side BHs. An example would be an office community of LUs may have one BH and two side BHs. These BH determinations are performed at regular intervals to insure that data is being gathered on the correct BH, it is common that some offices may change BHs seasonally. Data collection on a non-BH may result in an underestimation of traffic loads and under engineering of added equipment. The BH data is collected at regular intervals, normally a daily interval, and averaged over a specified periodic interval (usually a month).

An optional method of TCBH engineering for the LU is Coefficient of Variation (CV). This method ensures that variation above or below the engineered load does not cause the office average blocking to exceed the chosen service criteria.

6.1.1.1 Data Manipulation

Typically, twenty days of TCBH traffic values are averaged together each month and collected in a data base at the end of a yearly interval. The three highest months of traffic data are then averaged together to produce the three high-month average for the year or the ABS traffic. This three high-month average, commonly called the BS, is the value used in trending the traffic over an engineering period. These values are used to project the life of the current switching equipment. Because all offices do not have a definite three months in their BS, the traffic engineer must manually evaluate whether the office has one, two or three months in its BS. This approach is taken when one or two of the three highest traffic months are significantly lower than the other(s). Statistical methods for determining outliers may save the traffic engineer time and provide improved accuracy. This is one value used in trending for future growth or switch replacement engineering.

The ABS value is not sufficient to determine the amount of traffic in an office. As a result, TCBH engineering requires a measure of the peaked traffic in order to engineer the desired grade of service. This measurement is performed by collecting and charting HD traffic values and THD values. These values are the highest daily traffic loads in the year. In practice, the HD value is difficult to determine due to the small amount of data collected and the necessity of outlier rejection. Traffic associated with natural disasters or radio call-ins are not likely candidates for HD or THD traffic. In summary, the HD traffic is the highest daily traffic expected during the year, whereas the THD is the average traffic on the ten highest traffic days of the year. The TCBH engineering method for the*5ESS*® switch requires both HD and ABS traffic values. The most limiting case is used for equipment provisioning.

Outlier detection on HD and THD values is vital to the traffic engineer because it determines the cause of unusual high traffic. For example, random radio call-ins may influence the flow of traffic, thus creating an inaccurate traffic value.

6.1.1.2 Engineering Considerations

In order to average data on the *5ESS*® switch, it is suggested that the traffic engineer divide the office into communities containing SMs/SM-2000s that have similar traffic characteristics. Basic communities may be, but not limited to, one of the following:

- Remote Switching Modules (RSMs)
- RSM clusters

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- Optically Remote Modules (ORMs)
- Co-located ORMs
- ISDN SMs.

Each community may have a different end of engineering period for its equipment in the *5ESS*® switch. The Poisson engineering criteria for the *5ESS*® switch traffic-sensitive units are described in Table 6-1 for each of the three methodologies described.

Table 6-1 Engineering Criteria for Switch Components

EQUIPMENT	EVE	TCBH	
		HD	ABS
Line Unit/Access Interface Unit/Integrated Digital Carrier Unit	4 **b**	7 **b**	1.5 **b**
Digital Carrier Line Unit	4 **b**	7 **b**	1.5 **b**
High-Level Service Circuit	.05 **b**	0.1 **b**	□
Integrated Services Line Unit (ISLU)	□	7 **b**	□
Tone Decoders	.03 **a**	.05 **a**	.01 **a**
Conference Circuits: (3-port and 6-port)	.05 **a**	□	.001 **a**
RSM Umbilicals	.0005 **a**	.001 **a**	□
RSM Intra□Cluster Links (ICL)	.02 **a**	.04 **a**	□

Notes:

a. Poisson Tables

b. Capacity Tables

The values provided in Table 6-1 have been selected to provide an equivalent grade of service.

NOTE: Note that conference circuits are not HD engineered, and umbilicals, ICLs, and high-level service circuits are not ABS engineered. Engineering values corresponding to these positions are not provided in Table 6-1 .

6.1.2 EXTREME VALUE ENGINEERING

An important consideration in the engineering and administration of traffic-sensitive equipment on a distributed digital switch is the method used to forecast traffic loads. The EVE methodology provides a statistical alternative to traditional forecasting and administering methods.

Although the methodology has proven to be a good choice, the term "Extreme Value Engineering" has caused confusion for switch administrators to erroneously believe that the EVE methodology is used to engineer for extreme loads. The EVE method is used to engineer for any grade of service by using tools from the branch of statistics called the extreme value theory to characterize the traffic.

The basic engineering calculations in the EVE methodology are the OAM and EVHD. These calculations are only statistical projections.

The EVE methodology originated as an attempt to rectify some of the deficiencies of TCBH engineering. In order to be familiar with the EVE method, it is necessary to understand the differences of the EVE and TCBH methodologies.

The EVE methodology offers the following advantages over the TCBH method:

- The TCBH determination study is not necessary for engineering (the study may be required for switch administration purposes).
- Effects of day-to-day variation and BBHs are accounted for automatically.

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- Consideration of load variation results in better use and more efficient allocation of switching equipment.
- The EVE OAM service criteria is compatible with switching system performance indexes, which are reported monthly. The OAM service criteria is better related to customer satisfaction than the average service criterion in TCBH engineering.
- Since only daily peak loads are needed, data processing costs are reduced and collection of side hours is unnecessary.
- Above all, EVE provides statistically more reliable peak load estimates than the HD and the THD engineering. Replacing the HD and THD engineering by EVE eliminates the tendency to overengineer peak load-sensitive components, and hence results in equipment saving.

In traffic engineering, there are three elements, namely:

- Traffic load for engineering
- Service criterion
- Traffic capacity model.

Accordingly, a traffic engineering method may be characterized by the following:

- How the traffic load for engineering is derived from available load data.
- What service criterion is to be used? The service criterion specifies the level of service, and how the grade of service is measured in actuality.
- Given the engineering load and the level of service, which of the available traffic capacity models is to be used to determine the proper amount of equipment.

The BBH method for administration of LUs is very effective, switch administrators may look at reports generated by a support system collecting data from their digital switches and quickly assess the quality of service being provided. Line units that exceed either the 4 percent OAM blocking criteria or 1.5 percent ADP blocking should be flagged for further study. If the traffic levels in all LUs are below these two points, the office is providing a good grade of service in all LUs. Those LUs with less than 1.5 percent blocking in the BBH are assured to meet the 1.5 percent ABS blocking criteria.

The EVE data collection differs from TCBH data collection in two major ways. One way is that data collection is on a BBH basis rather than a consistent BH basis. This requires the hour in each day with the highest traffic for a unit be collected and used in the calculations for data trending. Since the peak loads are always collected, in whichever hour they occur, it is not necessary to perform BH determinations. Collection of data on the BBH ensures that the busiest traffic loads are always selected. At the end of the month, typically 20 days of data are used to find the ADP and standard deviation values for the traffic in that month. A statistical quantity called the OAM load is calculated from these quantities. The OAM value is the traffic load that is expected to be exceeded once during the month. This value is the 95th percentile of the probability distribution for the traffic. Similar to the TCBH methods, the three highest OAM values during the year are used to form the BS and to trend the traffic data.

The peakedness and seasonal variability of office traffic are taken into account by the EVE-computed OAM values. The EVE simplifies the engineering as compared to TCBH: only one input is required for EVE (OAM) rather than the two for TCBH (ABS and HD). The engineering load in TCBH engineering is taken to be the average of TCBH loads in the ABS (that is, ABSBH load) regardless of the load variation. The level of service is specified as the percent of blocking at the engineering load. The measured grade of

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service is the average blocking of TCBHs. Since the blocking is a convex function of the load in virtually all applications, it may be shown that the blocking at the average OAM load is smaller than the average blocking at TCBH loads. The difference depends on the day-to-day variation of loads.

Many traffic capacity models are available. The two most popular ones are the Erlang B model and the Poisson capacity model. The Poisson capacity model is used for TCBH engineering, since it partially accounts for the day-to-day load variation and predicts the measured grade of service more accurately.

For EVE, assume that CBHs and ABS are given. The maximum of the CBH loads in a day is called the daily peak (DP) load. The CBH when the DP load occurs is called a BBH. The BBH load averaged across the BS is termed the Average Bouncing Busy Hour (ABBH) or the Mean Daily Peak (MDP) load.

The load data needed for the EVE method are DP loads. The DP load in the BS is a random quantity that has a distribution F(x). The distribution F(x) was modeled as an extreme value distribution by Gershwin, et al. and Barnes, from which the name "Extreme Value Engineering" originated. Later Friedman showed that the normal-to-the-sixth distribution provides better agreement with empirical data than the extreme value distribution.

The 95th percentile of F(x) is designated as the OAM load. The name "OAM load" signifies that the DP load is expected to exceed the 95th percentile only once in a month (20 business days).

In EVE, the engineering load is taken to be the (estimated) OAM load. Clearly, OAM load depends on both the average and the variation of DP loads. This is how EVE accounts for load variation.

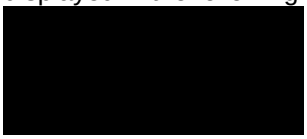
The level of service is specified as the percent of blocking at the OAM load. Note that OAM load is always larger than the ABSBH load. Thus, the blocking used in the EVE method should be higher than that in TCBH engineering if these two engineering methods display "comparable" amounts of equipment.

The grade of service is defined as the expected frequency that the blocking in BBH exceeds the level of service. When the office is properly engineered, the expected frequency should be 5 percent or once in a month.

The implementation of the EVE method in the *5ESS*® switch Digital Ordering and Planning System Module (DOPSMOD) employs the Poisson capacity model. Note that the Poisson capacity model predicts higher blocking, and hence gives more equipment, than the Erlang B model. In TCBH engineering, the Poisson capacity model is employed such that the additional equipment may be used to compensate for the day-to-day load variation and the retrial phenomenon. In EVE, however, the day-to-day variation has been accounted for by the use of OAM load; thus the Poisson capacity model will tend to overengineer, although this overengineering is somewhat compensated for by the choice of service level in EVE.

6.1.2.1 EVE Variables

The EVE has three basic variables for describing loads: ADP, OAM, and EVHD. The ADP load is the average of the highest loads each day averaged over a period typically 20 business days. The equation is displayed in the following Figure:



Where n is the number of days in the sample (typically 20), and DP is the daily peak load on day i. The DP load, in turn, is by definition the highest BBH load on day i. Since the ADP load is calculated from the BBH loads, it will always be greater than or equal to the ABS loads across the same period. The standard deviation of the DP loads is calculated as follows:

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[redacted]

This quantity provides a measure of the dispersion or spread of the traffic loads over the typical period of 20 days. This is an important quantity that allows us to engineer units having steep load service curves under widely varying traffic loads without having to guess at the HD loads as in TCBH engineering.

The basic engineering quantity is the OAM load. This is defined as the 95th percentile of the DP distribution. When a sample of 20 business days in a month are used, the OAM load is the load that will be exceeded on the average once a month. Most of the units on the *5ESS*® switch are engineered on the OAM loads. The OAM load has been empirically derived as follows:

[redacted]

The standard deviation factor represents the traffic to be served such that equipment may be engineered to a desired level of blocking. This is the variable that shows whether the traffic is fairly constant or widely variable.

The last important variable in EVE is the EVHD load. This represents a statistical equivalent to the traditional HD criteria and is based on the three high-month BS data. The EVHD load is typically used to engineer processors where the highest loads are important. The EVHD has been empirically derived as follows:

[redacted]

6.1.3 TCBH TO EVE DATA CONVERSIONS

Techniques for TCBH to EVE conversion have been previously published for precutover engineering of *5ESS*® switches when EVE data is not available. For completeness, this information will be reviewed in this section. The following equations have been empirically derived for ABS loads that are found to be greater than or equal to 200 Hundred Call Seconds (CCS):

[redacted]

Figure 6-1 Estimating the ABS Standard Deviation

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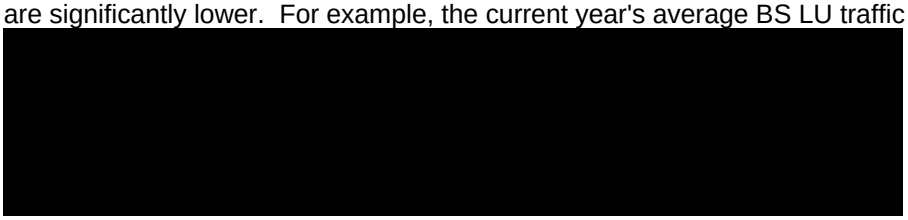
6.1.3.1 Data Manipulation

6.1.3.1.1 Monthly and Busy Season Calculations

The OAM traffic values for each traffic-sensitive unit must be evaluated separately. This calculation is done by collecting the daily traffic loads for each unit and at the end of the month performing the OAM calculation:

The OAM values should not be calculated by averaging unit data on a daily basis across a loading division and then calculating the OAM value for the loading division at the end of the month. (Such an approach is statistically invalid.) At the end of the month, the individual LU calculated OAM values should be averaged to obtain a community average for each unit type.

The three months during the engineering year with the largest OAM values for a community comprise the BS. Some communities may have only a 1- or 2-month BS if the load(s) during the other busiest month(s) are significantly lower. For example, the current year's average BS LU traffic is calculated by:



where LU OAM $CCS_{k,\,i}$ is the OAM load for LU_k in CCS for month i and NAL_i is the number of analog network access lines in the office at the end of month i.

The preceding computed value is projected to the end of the engineering period and multiplied by the number of analog NALs in the community projected for the End of Period (EOP) to arrive at the total LU OAM CCS required at EOP.

6.1.3.1.2 Outlier Detection

Outlier detection in EVE is performed by first calculating the OAM, ADP, and standard deviation values for a unit. A check is made to see if there are any data points greater than + or -3 standard deviations of the ADP value. These values are removed from the data, and the OAM value recalculated. Although 20 days of data are desired, at least 12 days of data should be available for a valid OAM calculation.

6.1.3.2 Engineering Considerations

The EVE is done via the unit OAM values averaged for the BS. In rare instances, there may be offices with fairly constant BBH traffic. This shows that the standard deviation of the traffic will be small. In these rare cases where the OAM traffic is only slightly larger than the TCBH ABS traffic, a switch engineered to OAM levels could be providing higher than 1.5 percent ABS blocking. In these cases, it is necessary to provision more equipment if there is a requirement to bring the ABS blocking level down to 1.5 percent.

6.1.3.3 Administration Considerations

The introduction of modular digital telephone switches is forcing the service providers to reevaluate service standards. The components of these digital switches, including the *5ESS*® switch, are virtually all sensitive

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to peak traffic loads. On the other hand, these same switches provide better service at average traffic loads. Many engineers have questioned how to use EVE for administration. The service criteria for ABSBH and HDBH varies, on the average, only slightly from the ABBH and EHD values. The more inconsistent the traffic BHs are the better ADP traffic values indicate the service being provided to the end customers. The ABS values will be missing many peak loads with higher blocking levels. The results of this should make the transition to EVE service standards relatively easy and desirable from a service standpoint.

6.1.4 ENGINEERING METHODOLOGY SELECTION FOR THE *5ESS*® SWITCH

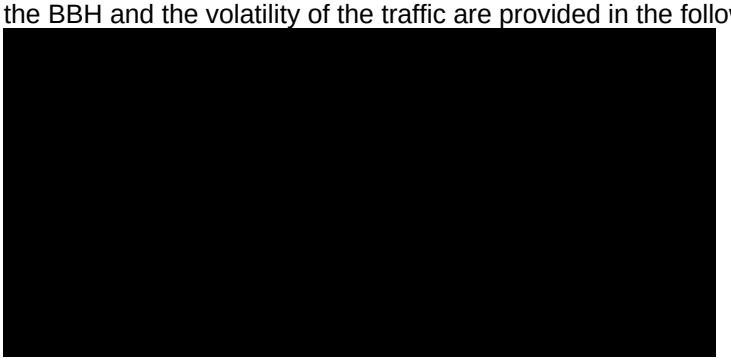
An important consideration in the engineering and administration of traffic-sensitive equipment on a distributed digital switch is the method used to project traffic loads. One type is the EVE methodology. The EVE method provides a statistical alternative to traditional projection and administration methods and has been used for several years by Lucent Technologies and various telephone companies.

This section discusses EVE administration techniques and how it applies to initial engineering, growth, and service criteria in a distributed digital switching system.

It has been found that a distributed digital switch may provide adequate TCBH service and still have undesired blocking and customer complaints outside the office BH. The introduction of the distributed digital switch architecture and modular growth of new equipment is driving traffic engineers and switch administrators to reconsider the meaning of both service and traffic loading on this type of switching equipment. The data collected and analyzed from offices is used to demonstrate the value of BBH versus time-consistent data collection and the relationship to service objectives in an office. The EVE methodology is the preferred method, not only for growth engineering and administration of existing switching equipment, but also for the engineering and administration of services, such as ISDN. In order to make the most efficient use of switching equipment, it is important to understand ISDN traffic variability for both, voice and data.

6.1.4.1 Background

The basic engineering calculations in the EVE methodology are OAM and EVHD. Both OAM and EVHD are statistical estimates. The criteria for the OAM calculation is based on the level of traffic a unit should exceed, on the average, once a month. On the other hand, the EVHD calculation is a statistical equivalent to the traditional HD criteria. Engineering and administration values that account for the average traffic in the BBH and the volatility of the traffic are provided in the following equations:



6.1.4.2 Data Collection

The CCS traffic data carried on the *5ESS*® switch LUs, which have a maximum of 512 line terminations and an 8:1 concentration ratio, was collected from several switch offices for this study. The offices studied were all equipped in this same manner. The LUs in the offices resided on the SMs/SM-2000s, which had four or five LUs per SM. In all the studies, the CCS traffic was limited by the network and not by the processor. The SM/SM-2000 performs about 97 percent of all call processing in the *5ESS*® switch with administrative functions being performed by an AM/CMP. The SM is designated to generate traffic measurements, while the AM collects each half-hour measurement from the SMs/SM-2000s. As a result, a report is prepared, which is either printed or funneled downstream to an operational support system. The

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office data used for this study was collected from the *5ESS*® switch TRFC30 report and the engineering support system. In the TCBH and BBH traffic study, the data was collected and analyzed from communities of co-located equipment.

6.1.4.2.1 Line Unit Load Service Relationship

In order to tie an engineering methodology to a engineered unit, the load service relationship of that unit must be considered. Figure 6-2 shows a plot generated from field data of the load service relationship in the *5ESS*® switch 8:1 LU. In this figure, the blocking within 50 CCS bands were averaged and plotted. The data for this figure was created from a sample of 80 LUs in two offices with a month's worth of one-half hour data. One of the offices studied was under engineered, allowing the collection of many points in the higher blocking ranges. The published Lucent Technologies engineering values for the 8:1 LU are as follows:

Figure 6-2 80 8:1 LUs - Blocking Averaged on 50 CCS Bands

6.1.4.3 Traffic Behavior and Engineering

6.1.4.3.1 Busy-Hour Determination

An important benefit of the EVE methodology is the elimination of the need for BH determinations (BH determination may be required for switch administration purposes). These determinations are expensive and time consuming. Table 6-2 shows an analysis of the BHs for five offices. Even in study offices that

have the most consistent BHs, C and D, only half the LUs, on the average, have their peak traffic in the office BH. Offices C and D are business metropolitan offices. Offices A, B, and E are residential offices with some business lines. The residential offices have the least consistency in their BHs, and provide the best opportunities for BBH engineering and administration methods. Selecting and using, for growth engineering, an office BH for any of the study offices will force the engineer to make adjustments to account for traffic outside the office BH to ensure that objective service is provided. The BBH data and EVE analysis takes the guesswork out of understanding the traffic in an office outside the office BH.

Table 6-2 Busy Hours for One Month's Data on Five Offices

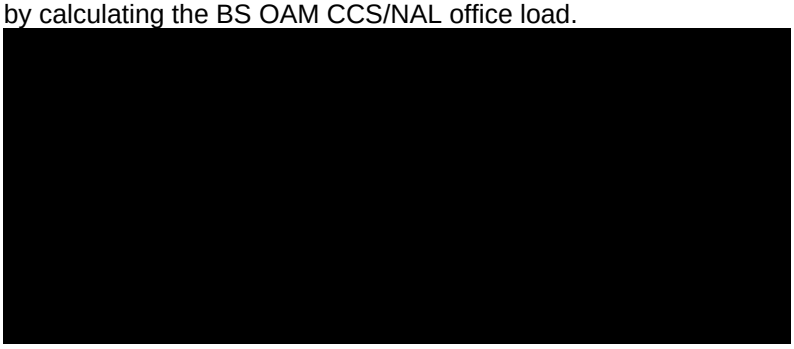
OFFICE	# BBH REPRE SENTED	MOST FREQUENT OCCURRENCE OF A BBH (PERCENT)	2nd MOST FREQUENT OCCURRENCE OF BBH (PRERCENT)	3rd MOST FREQUENT OCCURRENCE OF A BBH (PERCENT)	ALL OTHER OCCUR RENCES OF BBHs
A	*11*	29.8	15	14	*41*
B	*8*	30.3	23.1	22.2	*24.3*
C	*11*	52.3	27.3	7.7	*12.7*
D	*6*	48.6	30.8	9.7	*10.9*
E	*10*	30.8	24.4	23.5	*21.2*

If the traffic peaking outside the TCBH were within a few percent of the TCBH traffic, then the collection of BBH data would have a small impact on grade of service and future growth engineering. This has been found not to be the case, and specifically offices growing new SMs/SM-2000s may have distinctly different TCBHs on the growth SMs/SM-2000s as compared to the existing office TCBH. In a study office, not listed in Table 6-2 , one-third of the SMs/SM-2000s in the office had traffic in the office TCBH that only averaged 60 percent of the traffic in the individual SM/SM-2000 TCBH. This condition may be common with the addition of SMs/SM-2000s in an office when lines with characteristics different from the existing office are added. If the SMs/SM-2000s are divided into communities or loading divisions with similar BHs, additional equipment will be required due to trapped capacity. Additional communities will also involve more administrative effort.

6.1.4.3.2 EVE Engineering

Even though the EVE methodology provides a more accurate method of engineering, it is not always possible to use the EVE method to engineer an office because of the lack of data associated with EVE. This is the case mainly for initial engineering; since previous to the *5ESS*® switch, little EVE data was collected. These initial offices should be engineered using ABS and HD values. The engineer should attempt to determine the best HD and ABS ratio possible. After the offices cut over, it is possible to engineer growth jobs and monitor service with use of EVE data.

When equipment in an office is engineered, the traffic engineer generates EOP traffic projections. After the cutover of an office, the switch is monitored for the actual observed traffic to verify the capability of the office to handle the EOP loads. Global resources in an office, like conference circuits, should be monitored by calculating the BS OAM CCS/NAL office load.



where this equation assumes 3 months in the BS. The office EOP load is then:

BS OAM CCS(EOP) = NAL(EOP) □ (BS OAM CCS/NAL)

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(BS = Busy Season)

For local resources that depend on traffic in an individual unit, such as the LU, calculate the BS OAM CCS/NAL load for a community:

where: BM = Busy Month of the Busy Season

(Traffic is assumed to be spread fairly evenly across the community. Communities are generally co-located equipment within an office or remote cluster of SMs.)

6.1.4.4 Administration

6.1.4.4.1 BBH Administration

The BBH administration of LUs is very effective. Switch administrators may look at reports generated by a support system collecting data from their digital switches and quickly assess the quality of service being provided. The LUs that exceed either the 4 percent OAM blocking criteria or 1.5 percent ADP blocking should be flagged for further study. If the traffic levels in all LUs are below these two points, the office is providing a good grade of service in all LUs. For example, look at the data represented by Figure 6-3 . The dashed line represents the 4 percent blocking level to be exceeded on the average, at most, only OAM by any individual LU when considering BBH loads (not all loads). This figure represents 53 LUs, with a CCS traffic point plotted for each LU on each one-half hour of the 20 working days (Monday through Friday) in a month. A switch administrator would like to see, at most, 2 □ 53 points above this line to meet customer service and engineering criteria. However; if all 16 points had been due to one or two LUs, the switch administrator would have had a service problem in those LUs. (The data collected for this study was charted on the one-half hour to provide better granularity of the traffic. The engineering and administration is typically done by using hourly data. The switch administrator, in this case, would expect only 53 points to exceed the 4 percent blocking criteria.) In this example, there are only 16 points above this threshold. This office meets the EVE criteria and was providing good service to its customers.

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Figure 6-3 53 LUs - Data Points for Each LU Every Half-Hour for 4 Weeks

Additional lines being added to the office in Figure 6-3 should be assigned to those LUs with the smallest OAM CCS. If necessary a switch administrator may lower the traffic in the highest CCS LUs by moving lines with the highest usage from those LUs to LUs with the lowest OAM CCS. Using these two principles, a switch administrator may make the best use of the network capacity in an office. Administration by OAM load is important to account for variability in traffic.

Figure 6-4 presents another office with 30 LUs. Here, there are 119 points above the 4 percent blocking criteria instead of the expected 2 □ 30 points. This office certainly has a service problem. *5ESS*® switch LU has a steep load service curve with blocking increasing rapidly at higher CCS usage. In this office, there was not enough LU capacity to shift the traffic from heavy CCS LUs to light CCS LUs to meet service criteria.

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Figure 6-4 30 LUs - Data Points for Each LU Every Half-Hour for 2 Weeks

For this case, the switch administrator and traffic engineer must work together to add additional LUs and move the highest CCS lines from the heaviest OAM CCS LUs to the new LUs. In this way, the blocking during the BHs may be pulled under the 4 percent OAM level. The important point is to move lines from LUs with the heaviest OAM traffic rather than the heaviest BH traffic. This will insure good service for all LUs for all hours of the day and takes the traffic variability into account.

The office represented by Figure 6-4 was engineered with TCBH ABS data. Figure 6-5 is a plot of the data points in Figure 6-4 averaged by the half-hour. The office BH traffic in this plot meets the ABS engineered traffic level. The reason the office had service problems even though the ABS engineering was correct is because of the high variability of the traffic. The best way to understand this variability, which Figure 6-4 shows as two major BHs and one minor BH, is to study the BBH behavior of the LUs and to calculate the standard deviation of the traffic. The OAM traffic projection predicts the traffic loads seen in the office.

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Figure 6-5 30 LUs - Data Points for Each LU Every Hour for 2 Weeks

6.1.4.5 Service Criteria

The BBH reports provide the switch administrator a quick and efficient way to evaluate the service in an office. Typically, a monthly report from an operational support system will list LU identifiers along with the associated ADP and OAM values for those LUs. If all the ADP values are less than 1700 CCS, the switch administrator is assured that the blocking, at the average load, in each of the LUs is less than 1.5 percent both in the BBH and in the TCBH. The LUs with over 1700 CCS may be providing inadequate service and require administrative actions. The switch administrator should also glance down the column of OAM numbers to see if any are higher than 1870. If there are LUs with an OAM CCS greater than 1870, these LUs may also be providing inferior service. A LU may be over 1870 OAM and yet be less than 1700 ADP depending on the standard deviation of the traffic. The ADP and OAM calculations provide invaluable information to the switch administrators about the service in their offices.

The grade of service is dependent on the traffic within each LU. The LUs provide an excellent grade of service for CCS traffic below a threshold. Above that threshold, the blocking increases exponentially. Every 8:1 LU provides service for up to 512 customers. A customer on an individual LU sees his/her telephone service being sensitive mainly to the levels of traffic on the LU where he/she resides. Since the grade of service for each customer is primarily dependent on the LU where he/she resides, the service of an office should be based on the cumulative average BBH service of all the LUs. Measuring the service for this office by looking at a single BH tells an incomplete story. There may be groups of LUs with much higher individual BHs and higher blocking than that seen in the office BH. This was observed in the collected data for all seven offices within this study to varying degrees. An office may be within service guidelines for the office BH and yet be receiving excessive customer complaints due to blocking in hours outside the office BH. A full understanding of service provided within individual LUs is best gained by scanning a BBH traffic report for those LUs.

Office BHs may change depending on the season and varies with the day of the week. It is much more efficient to let a support system select the BBH for each LU on a daily basis rather than try to keep up with

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a changing office BH, which may be providing only part of the story in analyzing the service for an office. The grade of service for an office should be measured as an office average of all the LUs ADP values. Monitoring the ADP traffic at 1.5 percent blocking in an office will ensure that the commonly used 1.5 percent TCBH blocking criteria is covered. An office with a true TCBH will have the same values for ADP and ABS. In the office where the ADP value is greater than ABS, the end customers will receive the same quality of service as the end customers on the office with a true TCBH. Single LUs with BBH traffic above 1.5 percent ADP or 4 percent OAM levels may require administrative actions. In this way, all end customers in the office will be provided an acceptable grade of service.

6.1.4.6 Conclusion

The OAM administration techniques are efficient, cost effective, and help to provide uniform service to customers throughout an office. Engineering by use of BBH data with statistical projections of traffic loads allows the engineer to more closely match the traffic and customer service to the engineered equipment. Traditional use of engineering judgment for the unknown traffic outside the BH is not required. Busy hour determinations are unnecessary; and peak traffic for all hours in each LU is monitored for service, administration, and future growth engineering. In the past the use of TCBH methods was essential because of the difficulty in monitoring more than 1 hour of the day. Today, operational support systems are computerized, monitor traffic 24 hours a day, and may easily select BBH data for switch equipment like the *5ESS*® switch LU. The BBH methods and statistics provide much more accuracy and understanding of office traffic with fewer reports and less overall effort than traditional time-consistent methods.

6.2 SPECIAL STUDIES

6.2.1 DIGITAL SUBSCRIBER LINE MEASUREMENTS

6.2.1.1 Description

The Base Rate Interface (BRI)/Digital Subscriber Line (DSL) measurement feature generates usage totals and blockage peg counts of originating and terminating ISDN calls and reports this information to the TRFC30 Section 77 for each digital subscriber line allowed for collection.

The primary function of this feature is to collect, format, and report measurement data of individual users on BRI/DSLs for administrative load balancing of BRI/DSL lines in an ISLU/ ISLU2. The data is gathered from the SMs/SM-2000s every 30-minutes and formatted into reports sent to the following:

- Data Collection System (DCS)
- ROP (optional)
- Switching Control Center (SCC) (optional)
- Traffic Channel (TRFCH).

Four input IDs are used to study a BRI/DSL. These four IDs identify the Line Class Equipment Number (LCEN) for the ISLU, or (LCKEN) for the ISLU2. Six counts and the LCEN/LCKEN are contained in the TRFC30 Section 77 when this section reports to the Data Collection System (DCS), ROP, or TRFCH.

The TRFC30 Section 77 report is a special study section and is inhibited for collection by default. There is a limit on the number of BRI/DSLs that may be studied at one time and the amount that may be output to the ROP when Section 77 is allowed for collection and ROP output. All data collected for Section 77 is sent to the DCS and if allowed and equipped, to the TRFCH.

This feature has the following restrictions:

- ROP output for Section 77 is limited to six BRI/DSLs.

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- The number of BRI/DSLs that may be studied at one time is 19,500.

6.2.1.2 Limiting Collection and ROP Output for TRFC30 Section 77

To use this feature, see the TRFC30 Section 77 in 235-600-750, *Output Messages Manual* .

6.2.1.3 Activation and Deactivation

To use this feature, see the TRFC30 Section 77 in 235-600-750, *Output Messages Manual* .

6.2.2 DEFAULT CELL GROUP REPORT

6.2.2.1 Description

The *5ESS*® switch Division of Revenue (DOR) Default Cell Group Report (DCGRPT) feature provides the subscriber with origination and destination information for an Incoming Separation (INSEP) class and/or Destination Separation (DESEP) class causing the zero cell group traffic separation count to be pegged.

Call origination and destination information that identify calls pegging the default cell group is needed to identify incorrect DOR translations to ensure correct revenue sharing between the carriers and sufficient revenue collecting from the carriers by the operating companies.

Translation errors result in high peg counts in the default cell group number, and the DCGRPT assists the subscriber to identify the origination or destination information that is in error in the DOR translations. Translations define the INSEP/DESEP combinations (for example, 0,0; 0,1; etc) to a default cell group.

> ***NOTE:*** *Often, translators choose to use the zero (default) cell group. When INSEP and/or DESEP values are not assigned and default to zero, the call type pegs the cell group defined in translations, usually the zero cell group.*

When calls peg the (default) zero cell group, DOR cannot be correctly determined causing loss of revenue for the carriers and for the operating companies. This feature enables switching office personnel to identify the specific Directory Number (DN) that have not been assigned the correct value and to correct it.

This feature enables the switch administrator to identify calls pegging the (default) zero cell group by the DCGRPT printing a detailed error message when it encounters a call pegging the (default) zero cell group.

The DCGRPT has a limit of 32 reports and is not automatically generated on a daily basis. The DCGRPT must be activated manually. The purpose of the DCGRPT is to print a report for each call pegging the DCG and to print 32 separate reports before terminating.

Two factors that limit the zero cell group being pegged to 32 reports are as follows:

(1) Thirty-two is a manageable number of reports for the craftsperson to attain the needed information to repair the translations.

(2) Without a limit on the number of reports, this feature may cause the ROP to be flooded.

6.2.2.2 Activation and Deactivation

The input messages ALW:DCGRPT and STP:DCGRPT allows and stops, respectively, the reporting of the next 32 calls with INSEP and DESEP values causing the DCG to be pegged. The reporting of the zero cell group peg counts automatically turns itself off after printing the 32 calls pegging the count, but the craftsperson may turn it off at any time by entering the STP:DCGRPT. Re-entering the ALW:DCGRPT command after 32 messages have been output or after the STP:DCGRPT message has been input allows 32 more. There is no restriction on the number of times the DCGRPT may be requested by the

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craftsperson. Refer to 235-600-700, *Input Messages Manual* for details on these messages.

CAUTION: If this feature is allowed (ALW:DCGRPT) during periods of heavy ROP usage, the output of the default cell group report is subject to throttling. The impact of throttling is that from one to all of the reports, including the ``auto terminating'' message may not be printed. This report should not be used during these times.

Output message REPT:DCGRPT is provided. Refer to 235-600-750, *Output Messages Manual* for details on this message.

6.2.3 BLOCKED CALL INDICATOR REPORT FEATURE

6.2.3.1 Description

The Blocked Call Indicator (BCI) feature is developed to help the switch administrator identify LENs that are experiencing A- or B-link blockage in a LU concentrator and is used to improve load balancing.

Once activated, blockages are reported by output messages to the ROP and SCCs channel. (This report does not print as a section in the TRFC30 reports; therefore, it cannot be collected by the DCS.)

Blockages occurring in the *5ESS*® switch are pegged as dial tone delay (DTDPC Section 4) and terminating blockage (TMBLK Section 11) on a per SM/SM-2000 or per LU basis. Using the BCI ORIG command, the *5ESS*® switch prints the LEN that experienced DTD at the time it occurred. Utilizing the BCI TERM command, the *5ESS*® switch prints the LEN that experienced TMBLK at the time it occurred.

For originating calls, the same LEN may be recorded and reported in successive 4-second intervals for a single origination. This occurs if the caller remains off-hook during two or more successive 4-second reporting intervals while an A- or B-link blockage exists. Because a path through the concentrator is repeatedly sought, the same port continues to be recorded as blocked until the caller hangs up or a path through the A- or B-links is obtained.

For a blocked terminating call, the affected port is recorded and reported only once because there are no retries by the switch of blocked terminating calls.

When activating either the BCI TERM or BCI ORIG report, the switch administrator may choose an SM/SM-2000 or a range of SMs/SM-2000s to study. Also, the switch administrator may specify the number of blockage messages (from 1 to 1024) that are reported prior to the feature turning itself off in a given SM/SM-2000 (the default is 64).

The maximum number of output messages that are reported per SM/SM-2000 may be manually set by using the MAX field of the input message. Since originating and terminating reporting are activated with separate input messages, different MAX values may be used for each. The use of system resources for BCI to report A- and B-link blockage negatively affects call processing capacity when frequent blockages occur. If a large amount of blocking is expected, it is recommended that the elected value for maximum messages (MAX) be kept small to avoid excessive message processing.

When an SM/SM-2000 reports the last of its maximum messages, reporting is halted for that SM/SM-2000 only. Originating and terminating blockage are treated as separate reports, and are halted independently.

If the BCI feature is activated and it becomes desirable to change the SM/SM-2000 range or the Max value, the feature (either ORIG or TERM) must first be turned off with a STP:BCI message before restarting the feature with the desired values.

The BCI feature may be teamed with Line Unit Concentrator Utilization Measurement (LUCUM) feature to study line usage in concentrators. The BCI may be used to indicate the concentrators in which blockage problem are occurring. The LUCUM feature may be turned on to study all of the lines in the identified concentrators in detail. Individual line usage, attempts, and blocked attempts are provided in LUCUM to

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help determine an appropriate course of action.

6.2.3.2 Activation and Deactivation

The BCI reporting is invoked with the ALW:BCI command. Refer to 235-600-700, *Input Messages Manual* for details on this command.

Manually stopping BCI reporting is done with the STP:BCI command. Refer to 235-600-700, *Input Messages Manual* for details on this command.

NOTE: The originating and terminating BCI reporting are stopped independently of each other. Also, they may be filtered at an SCC or equivalent data surveillance system.

6.2.4 INDIVIDUAL LINE UNIT MEASUREMENT REPORT

6.2.4.1 Description

This feature allows the switch administrator to request traffic measurements from individual lines in the office. Refer to 235-600-750, *Output Messages Manual* for detailed information.

6.2.4.2 Activation and Deactivation

Refer to 235-600-700, *Input Messages Manual* for information on activating and deactivating this feature with an input message.

In addition, this feature can be enabled through Recent Change views 13.4 and 13.5. Refer to 235-118-2XX, *Recent Change Reference Manual* for detailed information on these views.

6.2.5 ADDITIONAL DATA ON CALLS ROUTED TO REORDER FEATURE

6.2.5.1 Description

This feature collects additional information for calls routed to reorder. The information provided assists the switch administrator in identifying switch-related problems or translation errors and in better engineering the switch resources to improve call completion performance of the *5ESS*® switch.

A reorder peg count is provided on the *5ESS*® switch TRFC30 Section 4 report. The count provides the number of calls that are not completed and given a reorder tone treatment because of switch-related problems (such as, unavailability of switch resources), or other conditions for which the local office may not be responsible (such as, invalid digits dialed).

The intended uses of this feature are as follows:

- To provide information to differentiate whether a reorder is because of a switch-related problem or generated by user action.
- To provide information for identifying switch problems (such as, hardware failure, resource shortage, etc.), and in reengineering the switch resources.

Upon activation of the feature, per call data such as originating SM, port number, time of event, call state, and called DN etc. are collected for calls that are being given a reorder tone.

Depending on the call stage, a call that is being routed to reorder may not have all the preceding information available at that instant.

In addition to the TRFC outputs, information collected is output on the ROP at the end of a 15-minute interval or when 30 reorder calls are recorded, or upon request by the craftsperson at any time. It is also

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sent to "down stream" processing systems.

This feature provides the following additional information, if available, for each call that is routed to reorder.

- Time of event
- Originating SM/SM-2000 and port number
- Call state (such as, dialing, transient, audible ringing, etc.)
- Terminating DN
- Terminating SM/SM-2000 and port number if available.

The *5ESS*® switch stores the reorder data, and prints on the ROP when the feature is terminated automatically. When the feature is terminated by an input message from the craftsperson, the *5ESS*® switch provides an option allowing the reorder data to be printed on the ROP. Default is termination without printing on the ROP.

This feature has the following limitations:

- This feature is limited to a maximum of 15 minutes or 30 reorder calls recorded on the reorder buffer per office.
- This feature does not allow multiple activations simultaneously. This feature must be terminated before it may be reactivated again.
- Depending on the call stage, this feature may not have all the information for a reorder call as described in Section 4. Usefulness of this feature for these cases relies on careful analysis of the available data as well as the TRFC15 and TRFC30 reports by the craftsperson.
- Information on the terminating end of a reorder call is probably unavailable for most of possible reorder scenarios. Therefore, except for the terminating DN, no other terminating information is included on the reorder reports.
- Reorder reports to the ROP are subject to throttling/brevity control of the human/machine interface subsystem; a reorder report may be lost under these circumstances.

6.2.5.2 Activation and Deactivation

This feature is activated and deactivated with the ALW:REORD and INH:REORD input messages. Refer to 235-600-700, *Input Messages Manual* for information on these message.

Activating the feature produces the REPT REORD output message. Refer to 235-600-750, *Output Messages Manual* for information on this message.

6.2.6 VERIFY MULTILINE HUNT GROUPS

The verify Multiline Hunt Group (MLHG) capability allows the service provider switch administrators to verify MLHG group and member information.

After the VFY:MLHG input message is typed, the ability to verify MLHG feature generates a report containing group and/or member information on a particular MLHG. The information is used to verify MLHG data. Refer to 235-600-700, *Input Messages Manual* for information on this message.

6.2.7 LU/ISLU LOAD ADMINISTRATION TRAFFIC MEASUREMENTS

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6.2.7.1 General

To properly administer the LU/ISLUs, measurements on usage should be available for each load component. The smallest load component in an LU is the Switch Group (SG) or half grid, and the smallest loading component within an ISLU is the Line Group Controller (LGC). Various traffic counts are available on the sections.

TRFC30 Sections 144 and 145 are used to assist Switch Administrators identify specific LU half grids or ISLU LGCs with excessive high or low usage and take the appropriate administrative actions.

- Section 144 provides statistics on usage per switch group. An additional blocking counter (OTBLK) was added via Secure Feature ID (SFID 169) beginning in 5E11.
- Section 145 provides statistics on usage per LGC.

Refer to 235-600-750, *Output Messages Manual* for more details on these traffic sections.

In line assignment, the objective is to maximize the number of assigned lines on an LU/ISLU without exceeding its usage capacity, expressed in CCS. For instance, under certain conditions, the recommended traffic capacity of an LU (with 8:1 concentration) which is engineered for 1.5 percent blocking in the *5ESS*® switch is 1700 CCS. This capacity is derived on the basis of data collected during a fixed hour when the offered traffic load is assumed to be the greatest in the office. If the average usage for all lines in an LU is 5 CCS, then only 340 (= 1700/5) terminations, out of 512, are possible. However, if the average usage on each line is 2 CCS, then the total usage is only 1024 CCS (512 □ 2) out of 1700. Yet no more than 512 lines may be accommodated in an LU with 8:1 concentration. So the task of the switch administrator is to assign as many lines to an LU without exceeding its engineered capacity.

6.2.7.2 Line Unit

One usage count is computed for the entire operational LU switch group (half grid) based on a 100-second scan of lines in the switch group. This count is available for LU1, LU2, and LU3. The switch group is also known as a half-grid. A switch group, shown in Figure 6-6 , has up to 32 lines spread across eight switches (0-7) with four lines per switch.

Figure 6-6 Switch Group Half Grid

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The number of individual usage counts for one LU is twice the number of concentrators (or the concentration ratio) in the LU as shown below:

CONCENTRATION RATIO	SWITCH GROUP
10:1	5
8:1	4
6:1	3
4:1	2

Traffic usage is computed for concentrator busy A-links. For each switch group, the traffic count reflects usage due to the following:

- Circuit-switched calls (voice and/or data)
- Terminal maintenance
- Network fabric exercise.

Any off-hook condition such as test calls reflects usage.

The traffic count does not reflect diagnostic maintenance.

This procedure is consistent with the way traffic and maintenance usage are measured and reported in other TRFC30 sections. Because there is a 2:1 concentration in the switch group, the theoretical maximum value per switch group is 16 □ 18 = 288 CCS per half hour. Of course, the minimum value is 0.

NOTE: Line units with no traffic usage and Line Units that are operational but out of service will all report 0 (zero) traffic usage.

Usage data for the LU half grid is reported by TRFC30 Section 144. The network switch administrator selects specific LUs (not switch groups) for study through Recent Change/Verify Views 13.6 (refer to 235-118-XXX, *Recent Change Reference Manual*).

6.2.7.3 Integrated Services Line Unit (ISLU)

The maximum value for a LGC cannot be easily determined. It depends on the number of nailed-up time slots (PPB channels) assigned. The number may easily vary from one LGC to another. A PPB nailup uses up a dedicated time slot on the LIDB, reducing the number of time slots available for circuit switch calls. This affects the maximum value of the usage traffic count in TRFC30 Section 145.

For each LGC with U- or T-cards, the traffic count reflects usage due to the following:

- Circuit-switched calls (voice or data)
- On demand B channel (packet-switched) calls
- Dedicated or nailed-up B channels
- Terminal maintenance.

On demand B channel usage must be included in the usage because it competes with circuit-switched calls (voice or data) for time slots.

The traffic count will not include the following:

- Diagnostic maintenance usage
- D-channel usage

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- Control time slot usage.

For each LGC with Z-cards, the traffic count includes the following usage:

- Voice
- Voice graded data service
- Terminal maintenance.

The LGC usage data is reported via TRFC30 Section 145 for the selected ISLUs. The network switch administrator specifies the selected ISLUs (not LGCs) through the Recent Change/Verify Views 13.6 (refer to 235-118-XXX, *Recent Change Reference Manual*).

NOTE: Neither the *5ESS*® switch nor DCS calculates weekly statistics on the usage measurement. The weekly statistics are computed in a downstream system, outside Lucent Technologies' domain.

6.2.7.4 Output

TRFC30 Sections 144 and 145 (refer to 235-600-750, *Output Messages Manual*) are output to the traffic channel or to the DCS channel. To avoid overloading the ROP, only six records may be sent.

6.2.7.5 Activation

These measurements are not automatically provided; they have to be activated for specific study groups. A network switch administrator may not want to collect data on all LU/ISLUs in the entire office; instead, the switch administrator may choose to focus only on overloaded or under loaded LUs. Therefore, network switch administrators must select the LUs and ISLUs on which data will be collected before the TRFC30 Sections 144 and 145 are activated. Each of the two TRFC30 sections may be activated individually.

To generate LU/ISLU traffic measurements the network switch administrator must do two things: first, set up a study group through RC/V view 13.6 (refer to 235-118-XXX, *Recent Change Reference Manual*), and second, enter an input message for that study group. These two procedures are described next.

6.2.7.6 Recent Change/Verify 13.6

RC/V view 13.6 (refer to 235-118-XXX, *Recent Change Reference Manual*) has been added to specify the LUs and ISLUs on which data will be collected. Note that the same view will be used for the LUs and ISLUs . (LUs and ISLUs are not mixed on a given view.)

Through RC/V view , the network switch administrator will set up a study group. For each LU/ISLU, up to 19 study groups (each study group containing not more than 100 LU/ISLUs) may be defined by the network switch administrator. To do this, the network switch administrator enters the study group number, unit type, and SM-LU/ISLU number (up to 100).

The RC checks whether the SM/SM-2000 and the LU/ISLU are operational. An error message is returned if these checks fail. An error is also returned by RC if the network switch administrator makes a duplicated entry. However, duplicate SM-LU/ISLU entries are permitted across study groups. Each study group may be activated and deactivated independently.

NOTE: The study groups and the units specified within the study groups by the network switch administrator will be saved following a software release retrofit.

As stated earlier, measurements generation and collection do not begin until the appropriate input messages are entered by the network switch administrator.

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In addition to study groups being specified by RC 13.6, ODA 5539 forms may also be used for office starts.

When an LU is added to the RC/V 13.6, the study group is already allowed for collection, and if the maximum DCS buffer is exceeded because of the additional SGs (LGCs), RC returns an error message. If, before the update is completed, the service provider allows another study group for collection or another TRFC30 section is allowed for collection, it is possible for the combination of this update and the newly allowed records to exceed the DCS buffer. In this case, an assert prints and the view fails.

If the status of an LU or ISLU is changed from operational to nonoperational and the LU or ISLU is a member of a study group, the LU or ISLU is deleted from the RC/V View 13.6. No indication of this deletion is given to the service provider.

6.2.7.7 Input/Output Messages

For additional information, please refer to the 235-600-750 *Output Messages Manual*.

6.2.7.8 Capacities, Limits, and Restrictions

6.2.7.8.1 DCS

The DCS-TRFC30 buffer size of 75,000 bytes may limit the amount of data an office may collect in one 30-minute period. Refer to the Increase *5ESS*® Switch TRFC30 Buffer Size feature (99-5E-4340) for more information on buffer size.

NOTE: The size of the TRFC30 buffer size is increasing for the 5E14 and later releases. One TRFC30 section has a maximum size of 32,000 bytes of data. In the worst case, if both of the TRFC30 sections are activated simultaneously, 64,000 bytes may be used, leaving only 11,000 bytes for other TRFC30 sections. In this case, the network switch administrators may choose to activate only one of the two TRFC30 sections.

NOTE: It is not required that only one TRFC30 section be activated at a time.

6.2.8 DIRECTORY NUMBER MEASUREMENTS (DNM) FOR DCS (NON ISDN)

6.2.8.1 Description

This feature is a special study providing peg count and usage measurements to the switch administrators using the DCS reporting mechanism, as well as the receive only printer and the traffic channel. The DNM feature, referred to as Customer Directory Number (CDN), works on all SM configurations.

The data gathered with this feature is valuable in determining how many calls a subscriber is missing and it provides switch administrators the ability to address the additional needs of subscribers.

Collection of these measurements may be taken on a maximum of 250 DNs (not necessarily sequential) associated with individual analog lines, the last member of a series completion list, lines that terminate on LUs (types: 1, 2 or 3), ISLU Z-card, or integrated Subscriber Loop Carrier *SLC*® Remote Terminals (RTs) on Digital Carrier Line Units (DCLUs) or Integrated Digital Carrier Units (IDCUs).

The standard data delivery path for switch administrators is via the EADAS Channel; however, Traffic Channel (TRFCH) output may be used and up to 20 DNs out of the possible 250 DNs undergoing data collection may be selected for output to the ROP during the next scheduled TRFC30 output. For additional information, refer to Sections 128 and 235 (ECDN) in 235-600-750, *Output Messages Manual*.

These measurements are as follows:

- Terminating Calls (TERMC)

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- Terminating Calls to Busy (TBUSY)
- Terminating Calls to Ring with No Answer (NOANS)
- Terminating Blockages (TRMBLK)
- Originating Calls (ORG)
- Originating Blockages (ORGBLK)
- Total Usage (USAGE) (originating and terminating)

6.2.8.2 Definitions

The definitions of the blockage measurements are provided in 235-600-750, *Output Messages Manual* .

6.2.8.3 Activation and Deactivation

For additional information, refer to Section 128 in 235-600-750*, Output Messages Manual*.

6.2.8.4 Compatibilities

This feature is compatible with all other features which may exist in the *5ESS*® switch.

6.2.8.5 Dependencies

There are no other features or services that must be operational in the switch or assigned to the subscriber before this feature may be implemented.

6.2.8.6 Limitations and Restriction

This feature may only be activated upon request from a switch administrator by an input message.

This feature does not increase the number of study sets allowed, which currently is one.

A maximum of 250 DNs may be studied at a time. The 250 DNs may all be on the same SM/SM-2000 or across multiple SMs/SM-2000s.

The measurements for a maximum of 20 DNs, currently under study, may be selected for ROP output.

The range of DNs specified in the allow and inhibit input messages, using the RANGE option, is limited to 25 DNs.

This feature is limited to individual analog DNs with both their service class and terminating class of service set to Individual (INDIV), except for individual PBX and individual INWATS lines.

This feature may be used to study the following:

- The last member of a Series Completion list.
- The lead line of a Line Time Slot Bridging (LTSB) DN.
- The master DN of a Multiple DN Line (MDNL). Terminations to dependent DNs peg the master DN.

This feature may not be used to study the following:

- Integrated Services Digital Network (ISDN) DNs.

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- Multi-Line Hunt Group (MLHG) DNs.
- Shared DNs.
- Multiparty Lines.
- The dependent DNs of an MDNL.

This feature does not provide accurate measurements for Precedence and Preemption DNs.

- Diagnostic and maintenance type activities do not peg these counts.

6.2.8.7 Interactions

6.2.8.7.1 Customer Dialed Account Recording (CDAR)

Calls blocked by CDAR do not cause the blockage counts to be incremented. Only the originating calls Peg Count (PC) is pegged for the originating DN.

6.2.8.7.2 800 Service (INWATS)

If the operating telephone company requires peg counts on an 800 number, the craftperson must enter the regular DN associated with the 800 number. When reporting the counts, the regular DN, not the 800 number is used.

6.2.8.7.3 Home Intercom

No terminating peg counts are pegged.

6.2.8.7.4 Attendant Control of Voice Terminals

Both originating and terminating restrictions are determined at the terminating end. Therefore, terminating calls are not pegged; however, originating calls are pegged.

6.2.8.7.5 Terminal Group Station Restriction (TGSR)

Both originating and terminating restrictions are determined at the terminating end. Therefore, terminating calls are not pegged; however, originating calls are pegged.

6.2.8.8 Abnormal Events Handling

If the switch administrator attempts to allow a DN for ROP output and it has not been allowed for collection, the system responds with the message "NG - NOT ALLOWED FOR COLLECTION".

When an allow request is made in the AM, and the SM/SM-2000 never receives that request, no counters are pegged for those DNs allowed during the request and no data is included in the next 30-minute report for those DNs. If the system switch administrator had allowed those DNs that the SM/SM-2000 never received, for ROP output, a "NO_DATA" message (refer to the OP:TRFC30-ND output message) would be printed for those DNs. This problem is self-correcting because at the next 30-minute report, a message(s) is sent from the AM to the SM with all the DNs that are allowed for collection on that SM. There is also the possibility that the SM/SM-2000 was power cycled or initialized due to retrofit and all data on the SM/SM-2000 was removed. If this is the case, the "NO_DATA" message is printed, for all DNs in the study set that reside on that SM, during each 30-minute report that follows. This problem requires manual intervention. The system switch administrator must inhibit from collection and then allow for collection, each DN that is both in the study set and resides on the SM.

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If an inhibit request is made by the system switch administrator, and the SM/SM-2000 never receives that request, the SM/SM-2000 responds with measurements to more DNs than expected, and no data is included in the next 30-minute report for all DNs on that SM. If the system switch administrator had allowed DNs, on that SM, for ROP output, a "NO_DATA" message would be printed for all DNs on that SM. This problem is self-correcting, because at the next 30-minute report, a message(s) is sent from the AM to the SM/SM-2000 with all the DNs that are allowed for collection on that SM. There is also the possibility that the AM was initialized with a level 54 and all data on the AM was removed. If this is the case, 30-minute output for this section terminates. This problem requires manual intervention. The system switch administrator must reallow the entire study set for collection and ROP output.

The switch responds to the "activation/allow request" with an "ALLOWED FOR COLLECTION" message. This message specifies the DNs that were added to the study set (for example, DN1) from the input message, and the DNs that were in the input message but not put under study (for example, DN2), including the reason why they were invalid and their corresponding SM/SM-2000 number. This response message also indicates the quantity of DNs currently under study.

Example: ALW:TRFC30,CLCT:CDN,DN=DN1-DN2;

ALW TRFC30 CDN ALLOWED FOR COLLECTION

ELEMENTS ALLOWED:

DN1

INVALID ELEMENTS:

DN2 <Invalid Reason> <SM Number>

ALLOWED ELEMENT COUNT: z (LIMIT= 250)

Changes may occur to a DN (that is, Recent Change modifications) after it has been placed in to the CDN study set, requiring the removal of the DN from the study set. Changes to the TERMCLASS, SERVCLASS, or LTM_TYPE where either the TERMCLASS or SERVCLASS are no longer set to INDIVIDUAL, or the LTM_TYPE is no longer set to LTM_OTHER is detected by the CDN self-audit, run every 30 minutes, and removal of the DN from the study set is initiated. There are other types of changes that initiate the immediate removal of a DN from the study set. The DN may be deleted from the switch, the Office Equipment Number (OEN) assigned to a DN may be changed, the DN assigned to an OEN may be changed, or two DNs may be swapped either intramodule or intermodule. When a DN is automatically removed from the CDN study set, for any reason, the switch notifies the system switch administrator with the following ROP message.

Example:

The system switch administrator uses a RC to convert DN1, currently in the study set, to a MLHG member. During the next 30-minute report cycle, DN1 is removed from the study set and the following message is

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output.

INH TRFC30 CDN INHIBITED

ELEMENTS INHIBITED BY CDN AUDIT:

DN1 <Invalid Reason> <SM Number>

Refer to 235-600-750 *Output Messages Manual* for a list of "Invalid Reasons" and their definitions.

6.2.9 Balance Tool

The balance feature allows the service provider to identify blocked calls and the Line Equipment Numbers (LEN) of up to 4 A-link blockers and move them to an Access Interface Unit (AIU) to prevent blocking. The switch administrator may use a RC to set the parameter, in this case the activation parameter. This causes the *5ESS*® switch to begin balance processing after the determination is made that the call cannot be established due to a path hunt failure in the originating or terminating analog line unit, which may be LU1, LU2, or LU3. The enable/disable parameter is then checked for the activation of the balance feature before any processing takes place.

The blocked call event is populated with the following information:

- Time
- Date
- LEN
- Directory number of the blocked port
- Origination/Termination flag
- Switch
- Level of the LEN on the four blocking call events.

The event is inserted into an HM message and sent to the AM when there are already eleven events.

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7. INTRODUCTION TO RESOURCE UTILIZATION

The following sections provide information for administering the *5ESS*® switch resources. The assumption is that the reader has a basic knowledge of the *5ESS*® switch architecture and operations. These details are provided in the 235-100-125 - *System Description* document and 235-900-XXX - *Product Specification* document. The following sections are divided into subsections providing resource utilization information on a physical group basis. Refer to the table of contents at the beginning of each section for complete description of the groups included. Each subsection provides information to administer the particular resource. The following subject areas are included in each of the subsections.

- ***Description***: A description of the resource is provided from a switch administration point of view.
- ***Engineering Considerations***: The capacity of the resource is described so that the administrator can monitor the resource on a daily basis and verify that the demand on that resource does not exceed its capacity.
- ***Assignment Guidelines***: The assignment implications of the resource are described. The various assignment options and the possible consequences of those assignment options are provided.
- ***Measurements and Primary Service Indicators***: The measurements and primary service indicators associated with the resource are described. These measurements are the means to monitor the capacity of the resource. Where appropriate, measurement thresholds are provided to indicate marginal performance or potential problems requiring manual intervention.
- ***Feature Impact***: Describes the impact that the resource has on the hardware involved.

Worksheets are provided, where applicable, to assist long-term capacity monitoring. These worksheets enable the administrator to determine if the capacity of the resource will exhaust before the end of the engineering period.

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7.1 GENERAL

7.1.1 INTRODUCTION

A primary objective of switch administration is to assure that the *5ESS*® switch continually delivers high-quality service to the subscribing customers. This objective may be achieved by monitoring and evaluating the performance of the *5ESS*® switch, on a daily basis, to identify potential problems that could cause service deterioration.

The capacity and maintenance status of the switching system resources may be monitored to assure that enough reserve capacity exists to provide a high standard of performance throughout the engineering period.

Generally, the performance level of the *5ESS*® switch is dependent upon how well the switch is engineered, maintained, and administered. External factors such as severe weather conditions or equipment failure may also cause depressed service levels for brief periods. Changing traffic patterns and certain equipment failure may be identified through switch surveillance so that corrective actions may be initiated to improve service performance, or to avoid service deterioration.

7.1.2 CAPACITY ADMINISTRATION

To perform the switch surveillance function, the capacities of various hardware and software items must be known and monitored. When an item is approaching the limit of its capacity, some actions may be initiated to avoid unplanned overflow situations. This section provides descriptions of unit capacities.

The following definitions are provided to assist in the understanding of the capacity information provided in this section.

Terminal Process: Call processing functions are distributed between the Switching Module Processors (SMPs) in the Switching Modules (SMs) and the Administrative Module/Communications Module Processors (AM/CMP). The SMP call processing functions are performed by terminal processes, which are created and exist only when the line or trunk it controls is active. There are different types of terminal processes. In general, the type of terminal process created to control a line or trunk depends on whether the terminal is a line or trunk, and whether the terminal is originating or is being used for termination. For a typical line-to-line call, there is a line origination terminal process to control the originating end of the call and a line termination terminal process to control the terminating end of the call. Associated with each terminal process is a data block containing data about the line or trunk and the call. Each terminal type (line or trunk), based on the data in the data block, uses a different set of procedures to perform function(s) for feature control (FC), administrative services, and terminal maintenance.

System Process: A system process exists as long as the *5ESS* ® switch is functioning. System processes are associated with noncall processing tasks such as maintenance and billing functions.

Half-Call: A half-call is the establishment of a path (in either direction) between a peripheral unit and the time slot interchanger (TSI). Thus, the terminating part of a call represents a half-call and the originating part of the call represents the other half-call. Each half-call generates a terminal process.

Call: A call consists of two half-calls. The call count is represented by the sum of the originating peg count and the incoming peg count. Some features such as 3-way calling require more than two terminal processes. The originating peg count is incremented whenever a customer has received dial tone and dialed at least one digit.

Message: A message is used to pass information between processes. A message may consist of data, requests, commands, and/or acknowledgments. The message count represents the number of messages exchanged between processors. (Messages between processes are counted only if the processes are in different processors.)

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7.1.3 MEASUREMENTS

The *5ESS*® switch software release generates, collects, and reports traffic, plant, and service measurements which are used to monitor particular aspects of a switching system operation over a specified period of time: 5 minutes, 15 minutes, 30 minutes, 1 hour, and 24 hours. These measurements provide a summary of events that have taken place within the switching system. The control of scheduling and printout of measurement data is also performed by the software release. Some of the reports may be activated or deactivated for local output as desired.

The *5ESS*® switch measurements are broken down so that an indicated trouble may be more precisely analyzed. Many call processing measurements are broken down into the following categories:

- Originating
- Terminating
- Connecting
- Incoming
- Outgoing.

An example of a call processing measurement is the ineffective attempts measurement which is broken down into originating and incoming ineffective attempts. Also, the call setup troubles measurement (a count of calls that encounter some kind of service-affecting equipment trouble) is divided into originating, incoming, terminating, outgoing, and connecting call setup troubles. The cutoff-call measurement is divided into switch and facility caused cutoffs.

7.1.3.1 Traffic Measurements

Traffic measurements, primarily used for engineering purposes and switch administration, provide the current status of the *5ESS*® switch as well as external resources such as trunks. These measurements provide a means to evaluate the load offered by subscribers to the usage-sensitive components of the *5ESS*® switch. This section is intended to aid the switch administrator in the management of the usage-sensitive components; therefore, the discussion concentrates on the traffic measurements.

7.1.3.2 Plant Measurements

Plant measurements provide data to evaluate equipment and craft performance, particularly to evaluate the impact of troubles on customer service. Plant measurements are divided into categories including base, plant service, and performance measurements. Base measurements provide counts of total service requests, billing volumes, and equipment quantities. Plant service measurements provide counts of customer perceptible service-affecting events related to the maintenance condition of the switching system. Performance measurements provide counts of events that, regardless of the effect on service, can be related to the maintenance condition of the switching system.

7.1.3.3 Service Measurements

Service measurements are used to evaluate the quality of telephone service to the customer. The main emphasis is on interruptions such as calls that fail to be switched or calls that are switched but fail to reach the talking state due to resource failures, and calls in the talking state which fail due to facility or switch cutoffs.

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7.2 CAPACITY UTILIZATION WORKSHEETS

7.2.1 INTRODUCTION

Where necessary, reproducible equipment utilization worksheets are included in the resource utilization subsections. These worksheets may be used to determine the projected exhaust date of the traffic-sensitive equipment in the *5ESS*® switch office. These worksheets can be completed and processed according to locally determined schedules and policies. Worksheets with instructions for the following *5ESS*® switch resources are provided.

- Digital line trunk unit (DLTU) - terminations
- Global digital service unit (GDSU) - conference circuits
- Local digital service units (LDSU) - tone decoders
- Analog line units - hundred call seconds (CCS) load
- Analog line units - terminations
- Remote switching module (RSM) umbilicals
- High-level service circuits (HLSC)
- Trunk units - terminations
- Digital carrier line unit (DCLU)
- AM and SM real-time call capacity
- SM memory.

7.2.2 EQUIPMENT UTILIZATION TASKS

To ensure maximum utilization of the installed switching components, several switch administration tasks must be performed. These tasks include:

- Monitoring office data.
- Determining the main station (MS) capacity of traffic-sensitive items. This determination should be based on the customer service objectives.
- Calculating the exhaust date of each traffic-sensitive item.
- Determining the corrective action required when the projected exhaust date will occur before the next scheduled growth job.

The engineering interval varies between offices based on the telephone company engineering policies and the accuracy of the forecasted office growth. A 2-year engineering interval is common. The telephone equipment order (TEO) is often written a year before the start of the job. In this case, the total period from the start of the TEO to the end of the period is 3 years. The demands on the traffic-sensitive items in an office can change during this time.

To achieve maximum equipment utilization at the desired level of service, the office growth patterns should be tracked to the TEO engineering data. Equipment utilization determines if the office has enough switching capacity to last through the next busy season and to the end of the engineering period.

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Normally, equipment utilization reports are completed after the busy season.

Proper equipment utilization practices may allow a growth job to be extended if the office has a surplus of switching capacity. If a shortage of switching capacity exists, the growth job may need to be rescheduled for an earlier date.

7.2.3 EQUIPMENT UTILIZATION TOOLS

In order to complete the necessary calculations and analysis, the following data, reports, and information are needed.

- Forecasts of lines, main stations, CCS usage per main station, trunks, and custom calling features
- Data on today's working lines, main stations, CCS usage per main station, trunks, and custom calling features
- Present TEO
- Current traffic and engineering data (summarization of 30-minute traffic data)
- Knowledge of changes in the office characteristics (including area transfers, scheduled growth jobs, new large business customers, and major trunking rearrangements)
- Data projections (projecting the known characteristics for today into the traffic characteristics for a future period).

7.2.4 EXHAUST DATE CALCULATIONS

Assuming the switch administrator knows the main station capacity for each of the traffic-sensitive items, an exhaust date may be calculated for each item. From the projected exhaust date, the administrator can determine if the office has the capacity to last until the next scheduled growth job. For each item, use the following steps.

(1) Begin with the end of period (EOP) date.

(2) From the forecast, read the equipment exhaust year.

(3) Calculate equipment growth per month for the exhaust year:

$$\frac{\text{Forecasted Equipment (End of exhaust year)}}{12} - \frac{\text{Forecasted Equipment (Start of exhaust year)}}{12} = \text{Growth per Month}$$

(4) Calculate exhaust month:

$$\text{Equipment termination into year} = \frac{\text{Equipment Capacity} - \text{Forecasted Equipment (Start of exhaust year)}}{\text{Growth per month}} + \text{Months into exhaust year}$$

7.2.5 PROJECTION OF OFFICE DATA

The EOP usage may be higher than the current office usage. After determining the limiting items in the office, each item should be analyzed. Knowing the present CCS/MS and MS capacity may indicate areas of potential risk such as:

- Possible service deterioration, or

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- Inability to meet customer demands due to insufficient or overloaded equipment.

Several projection methods are available. Each company's recommended projection method should be used to determine the EOP CCS/MS and MS capacity for the most limiting items.

7.2.6 EQUIPMENT MONITORING

The most limiting items in the office should be closely monitored to detect potential problems with exhaust dates. Monitoring these items can verify the projected exhaust dates. The actual capacity may be more or less than projected. Only the most limiting items in the office need be tracked in this manner.

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8. AM/CMP/CNI RESOURCE UTILIZATION

This section provides information for administering *5ESS*® switch administration module/communication module processor (AM/CMP). AM and CMP administration does not apply to the Very Compact Digital Exchange (VCDX) switching system. The assumption is that the reader has a basic knowledge of the *5ESS*® switch architecture and operations. These details are provided in the 235-900-113 - *Product Specification (Software Release 5E13 and later)* document.

The following subsections provide resource utilization information on a physical group basis. Refer to the table of contents at the beginning of each subsection for a complete description of the information included. Each subsection provides information to administer the particular resource. The following subject areas are included:

- AM/CMP Processor
- AM/CMP Real-Time Worksheets
- AM Memory
- AM Overload Control
- AM Disk Drive Facilities
- Common Network Interface Ring

Worksheets are provided, where applicable, to assist long-term capacity monitoring. These worksheets enable the administrator to determine if the capacity of the AM/CMP will exhaust before the end of the engineering period.

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8.1 AM

8.1.1 DESCRIPTION

8.1.1.1 3B21D

The 3B21D processor is packaged in two cabinets, basic and growth. The basic unit includes a duplexed Central Control (CC), Input/Output Processor (IOP), Disk File Controller (DFC), and Moving Head Disks (MHD). The growth unit is optional and uses a single-high unit, IOPs, and MHDs. Similar to the 3B20D, the 3B21D AM processor architecture consists of the following:

- ***Microstore*** - This control section of the processor decodes and executes all instructions in the 3B20D.
- ***Data Manipulation Unit (DMU)*** - Performs rotating, masking (manipulating data) as well as arithmetic and logic functions.
- ***Central Control Registers*** - Represent the hardware control status of the processor. They contain the system status registers, error registers, and interrupt source registers.
- ***Cache*** - Provides a means of improving the real-time capabilities of the processor by reducing the access time of frequently used data. The cache memory can store 2048 words.
- ***Main Store Update (MASU)*** - Used to keep the standby processor's main store updated by way of the main store update bus. It also controls main store bus access in the event that both the processor and the direct memory access circuits try to access the main store simultaneously.
- ***Direct Memory Access (DMA)*** - An interface controlling the data flow between the main store and the Module Controller and Time Slot Interchange Unit (MCTU). Once the DMA is initiated by the processor, the DMA controls the data transfer. When the transfer is completed, the DMA notifies the processor. This process of allowing the DMA to control the data transfer enables the processor to perform other tasks. The DMA interfaces with the other units by way of the dual serial channel. This path is used for all data transfers.
- ***Main Store (MAS)*** - Also called main memory, contains all of the executable programs and data used by the processor to control the *5ESS*® switch functions. These programs can be swapped into MAS from disk storage as needed.

The minimal configuration for the 3B21D processor consists of a basic cabinet. Additional cabinets may be required for housing 9-track Small Computer System Interface (SCSI) tapes. The maximum configuration is two growth units.

8.1.1.1.1 Central Control Unit

The 3B21D processor consists of two CCs. The maximum number of available DMA packs per basic unit in the Control Unit (CU) is two. The DMA packs are either active or standby. Only one DMA per side is required to handle all the assignment applications.

The CC provides the Central Processing Unit (CPU), memory, cache and DMA for the 3B21D processor, and is duplexed in the basic shelves. The physical address space for the 3B21D accommodates up to 128 MB of physical memory.

The DMA and Dual Serial Channel (DSCH) provide the following functions:

(1) Data transfer capabilities between peripheral devices and the memory

(2) Data transfer capabilities between AM and CM

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(3) Data transfer capabilities between AM and Common Network Interface (CNI)

(4) Interface to the IOPs and DFCs.

The 3B21D CC supports the following devices:

- 4 DSCHs per DMA
- 4 devices per DSCH
- 32 devices per CU.

> ***NOTE:*** The 3B21D DMA/DSCH interface does not support the non-SCSI Storage Module Device (SMD) disks.

8.1.1.1.2 Input/Output Processor

The IOP is a processor that controls input and output between peripheral units and the CC.

The IOP complex in the 3B21D basic unit may contain up to four Peripheral Controller (PC) communities per side. Additional PC communities are equipped in the growth unit if needed.

The 3B21D basic unit IOP may have up to four PC communities (PC0, PC1, PC2, PC3) per side. Each community may have up to four PC slots, with the exception of PC3 which is limited to three PC slots. Therefore, the maximum number of PC slots available per side is fifteen for the basic unit. If additional PC boards are required, the service provider has the option to decide whether to populate one or two growth units.

One growth unit (located on the top of side 1 of the basic unit) supports CU 0 and CU 1. This unit may have up to four PC communities with each PC community containing up to four PC slots. A maximum of sixteen PC slots are available per growth unit.

The minimum amount of PC slots available for the IOP in the basic unit, including both side 0 and side 1, is twenty-six (two slots in PC3 could be used for one SCSI MHD). The minimum amount of PC slots available for the IOP in one growth unit is eight (2 pairs of SCSI MHDs may be equipped in place of PC2 and PC3). The minimum amount of PC slots available for the IOP in the growth units, including both side 0 and side 1, is sixteen (five pairs of SCSI MHDs may be equipped).

The 3B21D IOP is designed to support a majority of the current PC boards with the same interfaces and components as the 3B20D IOP. The supported PC boards are as follows:

- Scan Point and Signal Distributor
- Maintenance Teletypewriter Controller
- Synchronous Data Link Controller
- Terminal Controller.

8.1.1.1.3 Disk File Controller

The 3B21D has two DFCs, each located in each basic unit. The DFCs function to support the SCSI MHDs and one or two 9-track SCSI tapes. However, a DAT tape is required for the 5e14 release. Each 3B21D is required to have at least one 9-track SCSI tape in the growth cabinet. The 3B21D may support up to three SCSI MHD pairs in the basic units and up to 5 additional SCSI MHD pairs in the growth units.

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Each DFC can support up to two SCSI buses. If more than 3 MHD pairs are needed, both growth units should be equipped, and the disk pairs can terminate on both SCSI buses.

8.1.2 ENGINEERING CONSIDERATIONS

The AM real time capacity for OA&M activities is closely tied to office size. In large offices, a significant amount of OA&M activities involving manual inputs are typically preformed between the hours of 8:00 AM and 5:00 PM. to be available for OA&M work. As the processor occupancy nears capacity, longer response times may be experienced.

8.1.3 ASSIGNMENT GUIDELINES

8.1.3.1 3B21D

No assignments are required for the 3B21D AM processor.

The 3B21D processor consists of two CCs. There can be a maximum of two DMA packs per basic unit available in the CU. The DMA packs are active and standby. One DMA per side is sufficient to handle all the assignment applications.

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8.2 AM/CMP MEMORY

8.2.1 DESCRIPTION

Figures 8.2-1 and 8.2-2 Show the basic partitions of the internal AM and CMP memory.

Figure 8.2-1 AM Memory Layout

Figure 8.2-2 CMP Memory Layout

8.2.1.1 AM Memory Types

8.2.1.1.1 Text

This is software release information.

8.2.1.1.2 Control Office Dependent Data

The Control Office Dependent Data (CODD) contains administrative data for redundant protected relations such as bit maps, dictionaries, global parameters, and ODA version information.

8.2.1.1.3 Unprotected Office Dependent Data

Unprotected Office Dependent Data (UODD) contains dynamic data that are represented as measurements for lines, Subscriber Line Instrument Measurement (SLIM) device information, and call

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processing information.

8.2.1.1.4 Static Office Dependent Data/Protected Random Access Memory

Static Office Dependent Data/Protected Random Access Memory (SODD/PRAM) consist of general trunk data, and Local/Remaining/Primary/Incoming Digit Interpreter (LDIT, RDIT, PNDIT, and IDIT) remarks. This memory may be increased after AM initialization. This data is sometimes referred to as PRDD.

8.2.1.1.5 Free Space

Free space is unused physical memory space available for allocation.

8.2.1.2 CMP Memory Types

8.2.1.2.1 Text

This is software release information.

8.2.1.2.2 Control Office Dependent Data

The CODD contains administrative data for redundant protected relations such as bit maps, dictionaries, global parameters, and ODA version information.

8.2.1.2.3 Unprotected Office Dependent Data

The UODD contains dynamic data that includes Simulated Facilities Groups (SFG) and trunk group members.

8.2.1.2.4 Static Office Dependent Data/Protected Random Access Memory

The SODD consists of trunk group and routing data, Line Class Code (LCC) data, and Digit Analysis Selector (DSS) data. This data is sometimes referred to as PRDD.

8.2.1.2.5 Free Space

Free space is unused physical memory space available for allocation.

8.2.2 ENGINEERING CONSIDERATIONS

8.2.2.1 Introduction

The following is recommended as a guide for AM memory equipage for switches with the 5E14 through 5E16.2 software releases.

8.2.2.2 3B21D

Table 8.2-1 summarizes current memory requirements.

Table 8.2-1 3B21D

Software Release	Memory (MB)
5E14	128
5E15	128
5E16.2	128/256*
*New 5E16.2 offices are equipped with the KLW256 which supports up to 256MB of physical memory, however only 128 MB will be defined since there is no need to increase the addressable AM memory in 5e16.2 beyond 128MB.	

8.2.3 ASSIGNMENT GUIDELINES

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The word ***parameters*** is frequently used to define resources which are used as key attributes in data base relations. These parameters are used to describe the makeup of the *5ESS*® switch. Examples of parameters include lines, screening indexes, and Business Residence Custom Services (BRCS) constructed feature identifications, and interpreted digits. Some of these parameters are assigned by the operating telephone company (route indexes, code indexes, group assignments, etc.). Some parameters are office dependent [Number Plan Areas (NPAs)]; some are software assignable (BRCS constructed feature identifications), and others are assigned as a function of another key. Parameter assignments made by the telephone company directly impact the administrator because it mostly affects memory.

An efficient way of utilizing memory is taking precautions to avoid wasted space on memory pages. It is suggested to number assigned items sequentially to avoid wasting dynamic memory pages.

Assignment numbers always start with 0, with some exceptions such as Multiline Hunt Groups (MLHGs) that do not allow the assignment of group number 0. If break points are desired, multiples of 64, 32, or other numbers as indicated by the memory requirement for that particular item should be used. This may be performed for either different types of trunks, or to provide businesses or assignment personnel with specific blocks of numbers. For example, if a particular item is assigned in groups of 8 on a 1/4 K page, it would be best to use multiples of 8. Standard 2-way trunk group numbers are multipled in this manner. These group numbers may range from 0-7, 8-15, 104-111, etc.

8.2.4 MEMORY MANAGEMENT

There are no dedicated TRFC30 measurements for monitoring AM memory usage. The **OP:ODD** command provides the necessary usage determination method as previously described.

8.2.4.1 Unprotected ODD

Unprotected Office Dependent Data is temporary in nature and exists only for the length of the processing task involved such as equipment status, work status, or work queues.

There is no specifically assigned memory area for the relations corresponding to these features. An office with few call pickup groups has more dynamic ODD space for other items. The dynamic ODD space cannot be used for static ODD.

8.2.4.2 Static ODD

Static Office Dependent Data is information that is infrequently changed, such as characteristics of a particular telephone office or features associated with telephone numbers. Much of the data resides in the CMP rather than in the AM.

8.2.4.3 CMP Memory

8.2.4.3.1 Description

The CMP performs the switching of data time slot messages between SMs and switching of control time slot messages between the AMP, CMP, and Signal Processor (SP). It also provides system synchronization and "quick pump" of SM memory capabilities.

8.2.4.3.2 5E14 Software Release

For the 5E14 software release, 51 MB is required in the CM2. This memory growth is done in the 5E13 software release by the installation of the additional TN1369 memory board. In this release, the BMI portion of feature **99-5E-4918** enables the pumping and access of the grown CMP ODD to the additional TN1369 memory board.

8.2.4.3.3 5E15 Software Release

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For the 5E15 software release, 51 MB is required in the CM2.

8.2.4.3.4 5E16.2 Software Release

For the 5E16.2 software release, 51 MB is required in the CM2.

8.3 AM/CMP OVERLOAD CONTROLS

8.3.1 DEFINITION

Overload is a condition in the *5ESS* ® switch that occurs when both the call processing and noncall processing loads offered to the system exceed its capacity. The overload condition must be detected and controlled before performance degrades.

There are two types of overload, real-time overload and shared-resource overload. Real-time overload occurs when there is insufficient time for the processor to perform all the work offered to the system. This is the primary overload and is critical to system performance, which leads to system delays when not corrected. Shared-resource overload occurs when there is a shortage of shared software resources requested in the system. The tone decoder, located in the SM/SM-2000, is the only monitored hardware resource contributing to the resource overload. This type of overload hampers further processing.

In general, real-time overloads are usually caused by a surge of call traffic. Shared-resource overloads are usually caused by inadequate resource allocation.

8.3.2 OBJECTIVES AND STRATEGIES OF OVERLOAD CONTROL

The general objective of overload control is to maximize system performance during periods of overload. More specifically, the purposes of overload control can be stated as follows:

- Ensuring system sanity and responsiveness
- Maintaining a high level of call processing
- Providing a graceful degradation of service, if degradation is inevitable.

To achieve these objectives, the overload control program constantly monitors the usage of the processor real time and the shared software resources. Overload control averages the usage over an appropriate time interval and compares the result with thresholds to determine the presence and the severity level of an overload. Overload control initiates appropriate actions to eliminate or minimize the effect of the detected overload conditions. These actions are a series of incremental controls ensuring a stable level of system performance with graceful degradation, if performance degradation is inevitable.

When real-time overload is detected, the general strategy is to:

- Limit the input of call processing work and, if necessary, the noncall processing work
- Defer the nonessential noncall processing work
- Ensure that a minimum of essential system checks are run to maintain the system sanity.

When resource overload is detected, the general recovery strategy is to:

- Identify and eliminate any resource hog to recover the overloaded resource
- Run sanity checks on the usage of this resource and correct the causing errors
- Reduce call processing and noncall processing activities which require this resource.

All of these control actions are fully automatic and require no immediate intervention by the central office craftsperson or surveillance center. However, the operating personnel are informed by overload control about the overload type, overload level, and the control actions. Upon each occurrence or escalation of

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the overload, a message is printed at the receive-only printer (ROP). With the exception of exiting the state of overload, overload de-escalation of messages is usually not printed on the ROP to reduce ROP clutter. However, the master control center (MCC) display pages are updated on every state change. A 15-minute periodic overload message is also printed at this time.

8.3.3 AM/CMP OVERLOAD CONTROL

The AM/CMP overload control checks for the following types of overload:

- ***AM/CMP Real-Time Overload:*** When the call processing occupancy exceeds its allocation, the AM/CMP enters into real-time overload.
- ***AM/CMP Resource Overload:*** The AM/CMP resource overload occurs when the software resources in the AM/CMP are not available.

8.3.3.1 AM/CMP Real-Time Overload Control

8.3.3.1.1 Approach

Every 6-seconds, AM/CMP real-time overload control monitors the amount of AM/CMP real time spent performing call processing. To avoid a rapid oscillation of overload states, moving averages of real-time usage and different intervals for change of state or escalation are used. All control actions are fully automatic and require no manual intervention. Even under the most severe overload level, the AM/CMP should maintain the rated call capacity.

8.3.3.1.2 Overload Levels

There are three types of overload states for AM/CMP real time:

(1) NONE: There is no AM/CMP real-time overload, and the route request throttle (the control mechanism by which AM/CMP limits call requests from the SMs) is not in effect.

(2) MINOR: This is the beginning state of the AM/CMP real-time overload. Several control strategies are activated. They are as follows:

- Throttling route requests from SMs
- Deferring nonessential tasks (AM only)
- Inhibiting avoidance routing (AVRT) for all SMs.
- Network Management is informed

(3) MAJOR: The same control strategies are used with additional throttling.

AM real-time overload control must go through two stages before applying controls. It must be enabled before it is activated. AM overload control is enabled when the 24-second moving average of the real time spent on call processing and higher priority tasks (this is defined as the internal "extended occupancy") exceeds 55 percent. This 55 percent internal extended occupancy is different from the external printed AM occupancy. For a particular *5ESS*® switch, the extended occupancy is from 2 to 9 percent higher than its corresponding printed occupancy. Therefore, the enable point corresponds to a printed occupancy value of 46 to 53 percent, depending on the actual amount of the high priority work. This real-time overload control enable point of 46 to 53 percent printed AM occupancy (or 55 percent of the extended occupancy) contains 40 percent for call processing and 6 to 13 percent for both call processing overhead and a minimum level of operations, administration, and maintenance (OA&M) overhead.

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Once overload control is enabled, it checks whether there is sufficient real time for a minimal amount of essential low priority (lower than call processing) tasks. These tasks mainly consist of audits and manually initiated OA&M activities. This check is based on the rate at which the low priority tasks are executed. If the call processing work exceeds its allocation, the rate of execution for low priority tasks may start to diminish.

If the rate of execution for these essential low priority tasks is satisfactory, overload control is not instituted. Under certain conditions, such as very low OA&M activity and little ROP printing being performed, the printed occupancy can climb to 60 percent and beyond without call processing controls being invoked.

If the rate of execution for these essentially low priority tasks is unsatisfactory, then AM overload exists. Only then is AM real-time overload control finally activated and the AM institutes controls on SMs to throttle route requests. The actual activation point usually corresponds to a printed AM occupancy of about 55 to 65 percent. The exact value depends on the individual office configuration, activity, and application.

The CMP overload control is triggered when the rate of execution of low priority tasks in the CMP falls below 9 percent (CMP total occupancy is greater than or equal to 91 percent) ***and*** CMP call processing occupancy is greater than 75 percent

When an overload condition is detected and throttling is activated, AM/CMP requests each SM to start throttling the rate of route requests (RRs) being sent to AM/CMP. There are 8 levels of this throttle. Call throttling applies to the CMP. The transition of the level depends on the incremental change in the overload condition. When the level stays below 7, the overload state is classified as MINOR. When the level escalates to 7 or 8, the overload state is classified as MAJOR.

8.3.3.1.3 Details of Control

Upon request from an overloaded SM, the AM/CMP attempts to route the (1-way) outgoing trunk calls around the overloaded SM. This control, AVRT, requires AM real time. Therefore, when the AM/CMP itself becomes overloaded, the AVRT service provided for the overloaded SM is inhibited.

Upon entering AM/CMP real-time overload, the AM/CMP requests all SMs to start throttling the RRs (sent from SM to AM/CMP to determine the call path information for each call). The same throttle level applies to every SM simultaneously. For a given SM, if the actual RR rate is higher than the current throttle level, the excessive RRs are blocked and the calls sent to reorder immediately without being queued for retry. The call percentage of each level of RR throttle is specified as shown in Table 8.3-1 .

Table 8.3-1 Route Request Throttle Levels

Route Requests Throttle Level	Line Originated Calls Allowed	Trunk Originated Calls Allowed	Overload State
0	100%	100%	NONE
1	92.5%	95%	MINOR
2	85%	90%	
3	70%	80%	
4	55%	70%	
5	40%	60%	
6	27.5%	45%	
7	15%	30%	MAJOR
8	7.5%	15%	

Certain types of calls receive preference in getting through the throttle, such as 911- and 0- calls. In addition, terminating calls are given 2 to 1 priority over new line originations.

8.3.3.1.4 General Comments on AM/CMP Real-Time Overload

When the AM/CMP enters an overload condition, it tells the SMs to reduce the number of route requests that are sent to the AM/CMP. Since no real time is expended by the AM to control calls, the AM/CMP carried load attains some steady state. At no time does the carried load decrease below the rated capacity of the switch.

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The AM/CMP overload control mechanism is designed to protect the switch from excessive load conditions yet maintain an essential amount of OA&M processing capability. Real time not used for OA&M work is available for call processing. Under extreme overload conditions such as sustained MAJOR overload, nonessential OA&M work should be deferred until the overload condition subsides.

Some customers may be affected more than others when overload controls are in effect. Since each SM is allowed to pass the same number of calls to the AM/CMP, different rejection rates are experienced in various SMs. That is, a customer served in an SM that is below the call rate limit set by a given level of control does not experience any different service than if no overload controls were in effect. A customer in an SM generating a larger call volume than the threshold could experience some calls being blocked.

8.3.3.2 AM/CMP Resource Overload Control

Overload control monitors the MCB, PCB, SCB, and TCB software resources in the AM/CMP. The base priority output queue (BPOQ) is added to the AM. The CMP also monitors the MSG and IAQ resources. Every 6 seconds, overload control monitors the count of free (unused) blocks for each resource. If the free count runs short (for example, less than 10 percent of the total amount), the AM/CMP enters resource overload for that type.

Upon entering MCB, PCB, SCB, or TCB resource overload, the AM/CMP notifies the system integrity monitor. The system integrity monitor is a software process that begins to identify and eliminate potential resource hogs to recover the nearly exhausted resource. During MSG or IAQ overload, the CMP applies the same controls as though a real-time overload occurred. During an AM BPOQ overload, nonessential tasks are deferred as they are during an AM real-time overload.

If any resource is exhausted before being detected by overload control, the system integrity monitor is informed immediately by the encountering process which detected the exhaust and takes immediate recovery action.

The AM/CMP resource overloads occur infrequently, and they are most often due to a combination of peripheral problems that occur simultaneously in several SMs. A common example is repeated carrier group alarm (CGA) failures that can occur if a major link encounters trouble. In this case a momentary AM/CMP message control block overload may be noted during the time the AM/CMP is processing the CGA failures. However, resource overloads that persist over long periods of time or occur quite frequently should be investigated.

8.3.4 NETWORK MANAGEMENT

When call attempts in a telephone network rise beyond the capacity of that network, the overall performance of the network degrades. The network management (NM) programs of the *5ESS*® switch provide real-time surveillance and control techniques to minimize this degradation, optimize call-carrying capacity, and maintain network integrity during periods of stress caused by either traffic overload or failure conditions. Whereas the *5ESS*® switch internal overload controls maximize the efficiency of the switch under overload, the *5ESS*® switch NM controls maximize the performance of the network by contributing to the optimization of traffic flow.

The NM includes automatic and manual controls. Automatic controls are activated when the switch enters AM/CMP real-time overload. Manual controls are activated by the manual input commands (on-site or remote from network management center). Although the automatic NM controls focus on helping the overloaded switch, the manual NM controls emphasize maximizing the network resource utilization. The NM controls are as follows:

(A) Automatic controls

- Selective incoming load controls (SILC) - for non-CCS network.

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(B) Manual controls

- Code controls
- Trunk Group controls
  - cancel to (CANT)
  - skip (SKIP)
  - cancel from (CANF)
  - Reroute.

The DOC is an automatic CCS NM control. In a CCS network, when a *5ESS*® switch enters AM/CMP real-time overload, all the connecting switches are informed immediately and start to throttle the calls destined for that overloaded switch. The controls available to the connecting switches are CANT and SKIP.

The SILC is an unilateral, autonomous NM control for non-CCS network. In a non-CCS network, when a *5ESS*® switch is in AM/CMP MAJOR real-time overload, a certain percent of the incoming trunk calls on manually specified trunk groups are blocked by SILC. The control action is confined within the overloaded switch.

The trunk groups for both DOC and SILC must be manually designated by the craftsperson. Once the trunk groups are assigned, the activation or deactivation of the control is automatic.

Code control blocks traffic to destination codes that are hard or impossible to reach. This conserves network resources for other traffic. Code control is most effective for controlling focused overload, a condition characterized by a surge of traffic from many parts of the network to a single office or destination code. Call gapping is used to regulate the maximum rate at which calls are released toward a destination code.

Manual trunk group controls can be divided into two classes: prehunt and posthunt. Prehunt controls are applied after a trunk group is chosen but before the hunt for an idle member starts. Posthunt controls are applied after the trunk group hunt fails to locate an idle member but before alternate route treatment is applied.

The trunk group control takes effect when either the percentage of direct route traffic offered to the trunk group exceeds a threshold, or the percentage of alternate route traffic offered to the trunk group exceeds a threshold. The threshold for prehunt controls is the percentage of all calls attempting to select a member in a trunk group; and for posthunt controls, it is the percentage of calls failing to select a member in a trunk group. Direct route refers to the first choice trunk group in the normal routing chain, and alternate route refers to the subsequent choice trunk group(s) in the normal routing chain.

The CANT is a prehunt control which cancels traffic destined for a specified trunk group. The SKIP is a prehunt control causing a given trunk group to be skipped and alternate routing to another trunk group in the routing chain occurs. The CANF is a posthunt control which cancels traffic overflowing a given trunk group. The reroute is a posthunt control. When reroute takes effect, a substitute reroute routing chain is traversed. If the substitute reroute routing chain is exhausted, routing continues in the normal routing chain unless specified otherwise.

8.3.5 USER ADMINISTRATION

During periods of overload, the subscriber may experience delays in dial tone or the call may be blocked.

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The overload control feature minimizes the effect of overload so that the telephone service is affected as little as possible. For exchanges with ESP enabled, subscribers designated as "essential" receive priority originating service during periods of extreme overloads. No line or trunk is permanently blocked or delayed during overloads.

The operating telephone company personnel can make requests by way of the MCC video display terminal for overload status information. The overload status information consists of a list of overload monitors and controls in effect. Whenever the overload status of a processor changes, a message is printed at the ROP and the MCC pages are updated. The MCC Page 109 indicates the status of overload conditions, if they exist, in the AM, CMP, DLN and SM. Page 109 provides the capability to request specific SM or CMP overload status and either to allow or inhibit ESP. The capability to request specific SM or CMP information is provided from MCC Page 170. Page 109 provides only a summary status of what processor, if any, is in overload. Page 170 describes the type of overload that exists. In addition, manual input messages may also be used to request overload status information and to allow or inhibit ESP for the *5ESS*® switch.

8.3.5.1 Load-Service Measurements

In cases where a *5ESS*® switch is operated beyond its rated capacity, load-service performance may be measured using switch data. The summation of the BLKOVD counts from all SMs (TRFC15 Part 2 or TRFC30 Section 4) divided by the corresponding sum of ORIGPC + INCPC (TRFC15 Part 1 or TRFC30 Section 5) provides the calculated percent blocking due to the AM/CMP throttle request during overload.

8.3.5.1.1 AM Route Request Throttle

AM occupancy for calls need be considered only if no DLN is equipped As the call load placed on the switch increases, the AM occupancy percentage rises. At some level of call volume and OA&M activity, the AM occupancy triggers AM overload controls. One control is the route request throttle, which limits service requests from the SMs in order to allow the maximum possible number of calls to be successfully processed by the AM.

8.3.5.2 CMP Load-Service Relationships - Software Releases 5E10 And Later

The CMP handles the call processing that in prior releases was done by the AM. With very high call loads and high recent change activity, the CMP can enter real-time overload. To maintain peak performance under overload, the *5ESS*® switch has a real-time overload control for the CMP that throttles an appropriate fraction of call originations; see AM/CMP Real-Time Overload Approach for details.

Although the overhead for the AM depends on the number of SMs, the overhead for the CMP does not. In contrast, the monitor in the CMP for the real-time overload control depends on the level of recent-change work, whereas the monitor for the AM does not have this dependence. Section 126 of the TRFC30 report, provides data for obtaining the CMP occupancy from recent-change work. The occupancy from recent-change work is:
PERCENT OCCUP - CALL OCCUP - (PERCENT OCCUP at no-load)

NOTE: PERCENT OCCUP at no-load is equal to PERCENT OCCUP when no calls or recent change work is being done.

As stated in AM/CMP Real-Time Overload, the CMP call capacity will normally set the overall switch capacity with 65-75 percent of the CMP real time allocated to call processing. When the switch is engineered for 65 percent occupancy of the CMP for call processing, the switch still exceeds the committed capacity for the full range of office applications even under conditions of simplex failures in critical resources. In particular, the capacity still exceeds 1,500,000 calls/hour for an EQPOTS office, 850,000 calls/hour for a Metro office, and 900,000 calls/hour for a tandem office with 100 percent SS7 traffic. Given the nominal, non-failure, state of critical components, the CMP is the most limiting resource

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for call processing for Metro offices.

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8.4 AM DISK DRIVE FACILITIES

8.4.1 DESCRIPTION

The disk drive facility for the *5ESS*® switch stores large amounts (hundreds of megabytes) of data. This is more than can be stored in the main memory areas of the switch. The disk drives are much slower than random access memory (RAM) but less volatile. Additionally, this facility is less expensive than main memory. The two following descriptions apply to the disk drive facilities of the two processors associated with the *5ESS*® switch. The 3B20D processor was associated with all switches prior to 5E9(1). New office starts beginning with software release 5E9(1) were equipped with the 3B21D processor.

8.4.1.1 3B20D

The *5ESS*® switch may be equipped with one or more pairs of Small Computer System Interface (SCSI) disk drives. The number of disk-drive pairs depends on the number of switching modules (SMs) and remote switching modules (RSMs) and the amount of automatic message accounting (AMA) data to be stored on disk. The types of information stored on the disk include:

- Backup copies of AM/CMP and SM(s) software release program.
- Backup copies of the *UNIX*® operating system.
- Backup copies of AM/CMP and SM(s) static office dependent data (ODD).
- Disk-resident ODD. These relations, called disk ODD (DODD), are stored only on disk and are accessed directly from the disk. This is done to better utilize the AM/CMP memory. Two backup copies of disk-resident ODD are retained on disk.
- AMA records.
- Logging data [history of craftsperson input/output, customer-originated recent change (CORC), recent change (RC) activity, etc.].

For more details concerning the specific information contained on the disk, and the associated disk partitions, refer to the 235-105-210 *Routine Operations and Maintenance Procedures* and 235-600-31X *Equipment Configuration Data/System Generation (ECD/SG) Data Base Manual*.

Each disk drive can be divided into a maximum of 64 partitions. Each of these partitions has a preset name and size which are permanent. There are two types of partitions: file partitions and file systems. The file partitions are basically large files containing raw data records. The file systems contain data records grouped into files which have individual names, sizes, creation dates, etc. The files are contained in directories and may be modified or removed as necessary. Each file requires one or more blocks of disk memory each containing 512 bytes of data.

8.4.1.2 3B21D

The 3B21D can support up to three SCSI Moving Head Disk (MHD) pairs in the basic units and up to two additional SCSI MHD pairs if one growth unit is used. Up to five additional SCSI MHD pairs in the growth units can be supported. Although a SCSI MHD physically contains a 1 GB capability, initially only 600 MB was allocated to maintain compatibility with 3B20D processors. The 3B21D processor used the "66" base configuration (described in section 8.4.2.5). This consisted of one pair of primary 600 MB usage coupled with one pair of secondary 600 MB usage. The software backup disks (MHD #14 and or MHD #15) and other optional disks also used 600 MB. The "66" base configuration supports 155 MB of AMA and 213 MB of SMODD. The 3B21D Direct Memory Access (DMA)/Dual Serial Channel (DSCH) interface only supports the 1 GB SCSI disk drives. Starting with software release 5E10, the "1010" configuration is supplied for all new offices.

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Each Disk File Controller (DFC) can support up to two SCSI buses (SBUS A & SBUS B). If one growth unit is equipped, then the SCSI MHDs terminate on SBUS A. If both growth units are equipped, then the SCSI MHDs can terminate on SBUS A & SBUS B.

8.4.2 ENGINEERING CONSIDERATIONS

8.4.2.1 AMA Billing Records

Each *5ESS*® software release supports a number of disk configurations, which allocate disk storage in various ways. To ensure the accuracy of billing records, it is recommended that there be sufficient disk memory for storing five days of AMA data.

It is possible to estimate the AMA storage needs for a specific office by computing a weighted average based on the types of calls that generate AMA records and the average record lengths.

The fields for AMA records such as sensor type, sensor ID, recording office type, and recording office ID are common to every AMA record. Therefore, they are not stored on the disk regardless of the type of AMA option used (teleprocessing or tape). After being engineered, a switching office has the flexibility to change the option without reengineering the AMA disk space. This means that the AMA disk memory engineering is independent of the AMA option used by the switching office.

Table 8.4-1 can be used to estimate AMA disk storage requirements.

Table 8.4-1 AMA Disk Storage Worksheet (MB)

1.	Enter number of local circuit-switched AMA records per day		□ 48	=
2.	Enter number of local-toll circuit-switched AMA records per day		□ 64	=
3.	Enter number of other InterLATA type AMA records per day		□ 71	=
4.	Enter number of packet-switched AMA records per day		□ 90	=
5.	Enter number of LASS SCA/CAR AMA records per day		□ 106	=
6.	Enter number of other LASS type AMA records per day		□ 80	=
7.	Enter number of AIN DB Queries that create AMA records (containing AMAslpID) per day (includes LNP)		□ 53	=
8.	Enter number of AMA records with modules attached per day multiplied by the average number of modules per record.	□	□ 12	=
9.	Sum of items 1 through 8			
10.	Enter number of days of AMA disk storage required			
11.	Multiply items 9 and 10			
12.	Divide item 11 by 1,048,576 which will represent the total disk storage requirements in MB.		□ 1,048,576	=

The calculations in Figure 8.4-1 may be used to determine the number of AMA blocks used in a day and AMA block storage capacity. The third calculation provides the ability to convert to kilobytes. A switch administrator who has back browsing capabilities on their switch to gather switch AMA information may also obtain the value for 1B (00:00 report output). **Caution** should be used when using this approach because the information represented may be less or more than a 24-hour period. The calculation 1B is the preferred choice.

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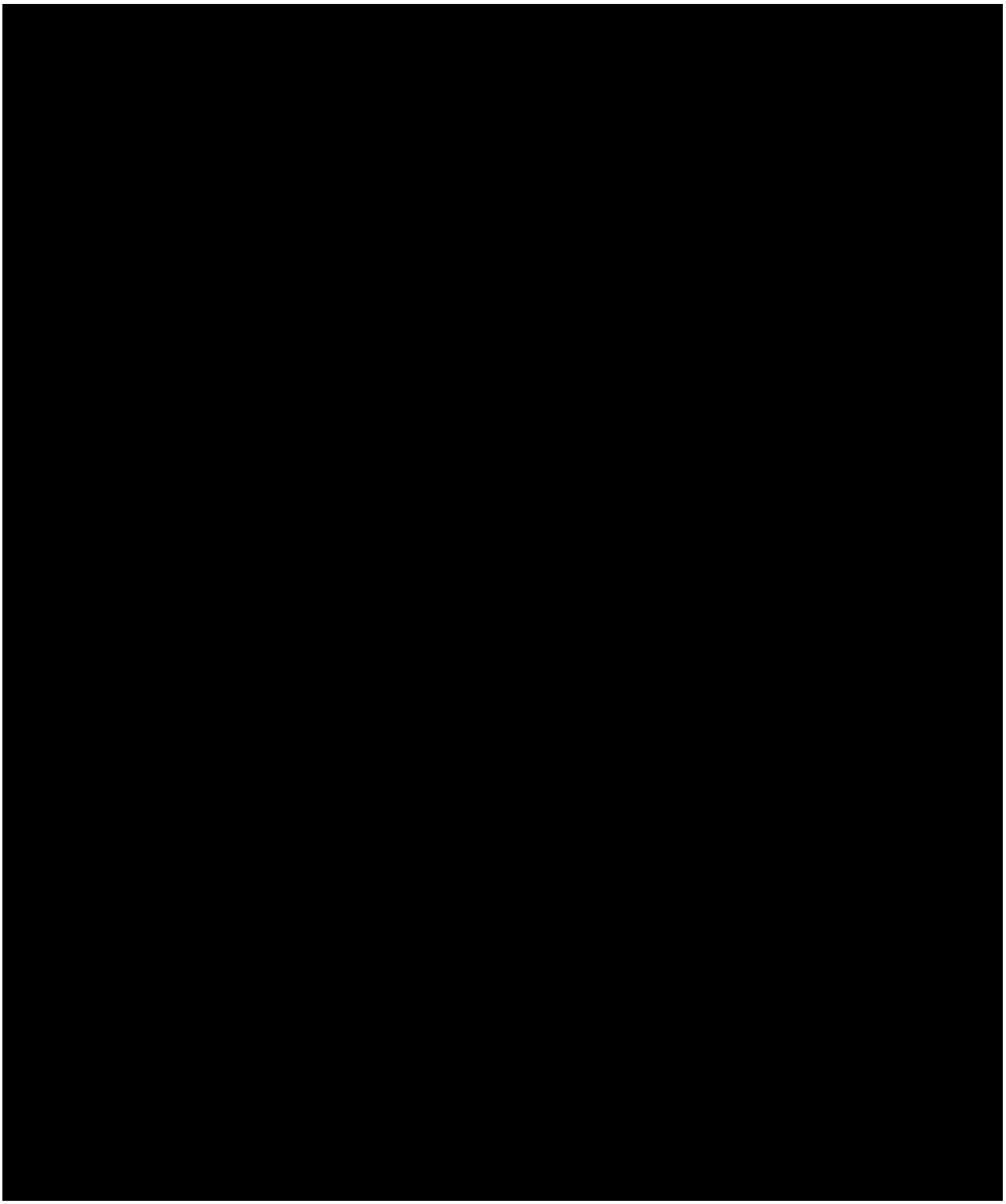

Figure 8.4-1 AMA Block Calculation

8.4.2.2 Disk Engineering Triggers

Optional disk pairs can be provided only for systems employing the 340-MB disk configurations. For new or retrofit offices, optional disk pairs are laid out in a number of fixed combinations. However, live offices may use disk growth procedures to grow optional disk pairs using any of the optional layouts available.

Four types of transitions may involve disk drives. They are as follows:

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- ***Disk Growth*** - Disk growth is the addition of new disk drives. This growth is done in pairs of drives except in the case of software backup disks, which are grown singly. A single pair of 300-MB drives may be grown to 2 pairs of 300-MB drives, and a single pair of 340-MB drives may be grown to 2 pairs of 340-MB drives. The layout on the existing disk pairs does not change, and no system boot is required. The additional pair of disk drives is then used to provide additional AMA storage unless a disk reconfiguration is subsequently performed.

- ***Disk Conversion*** - Disk conversion is the process of replacing one type of disk drive with another. This may be desired to gain the improvements previously described or it may be required to provide additional disk space. Disk conversion does not provide for increased disk allocations, but only changes the physical hardware. A system boot is not required for disk conversion.

- ***Disk Reconfiguration*** - Disk reconfiguration is the procedure used to change the allocation of disk memory. This procedure allows an office to be changed from one disk configuration to another. This could be a configuration change to increase ODD space (such as a change from a 340 SML to a 340 MED). Reconfigurations can only be performed to larger capacity configurations; that is in the order given in the capacity tables. Reconfigurations from or to optional layouts are permitted; The SM ODD space may be reduced as long as sufficient space remains for the backup ODD files. Disk reconfiguration requires a system boot; however, the SMs are not pumped, and call processing is not affected.

- ***Retrofit*** - During any retrofit future growth should be considered and coordinated with the capacity requirements provided in this section to ensure that the office is engineered with the appropriate disk configuration and the appropriate number of disk pairs. The expected end-of-engineering period (EOP) system configuration (number of SMs, RSMs, etc.) should be considered when engineering the disk drive facilities.

Two separate growth procedures are supported for low level Equipment Configuration Data (ECD), access for ECD manipulations for 3B20D processors and high level forms used for 3B21D processors.

The following is a summary of the 3D21D procedures:

- Growth of simplex SCSI peripheral units. These peripherals include 1 GB SCSI software backup disk drives and SCSI 9-track tape drives.

- Growth of duplex pair 1 GB SCSI disk drives.

NOTE: Only 1 GB SCSI disk drives are supported on the 3B21D processor. In addition, a mixture of SMD and SCSI are not supported on the 3B21D processor.

For more information on disk reconfiguration procedures, refer to - 235-105-210 *Routine Operations And Maintenance*. Details concerning retrofit may be found in - 235-105-XXX or 235-106-XXX *Software Release Retrofit Procedures 5EXX*.

8.4.2.3 Engineering for Dual AMA Stream

The engineering rules for using dual AMA streams depends upon the daily amount of AMA data generated in a switching office. It also depends upon the throughput of the AMA output option used (for example, either tape or teleprocessing).

The following are assumptions used to derive the rules:

(1) The AMA data stored on the disk for one day are written to tapes or teleprocessed during the next day.

(2) A minimum of 8 nonbusy hours a day are available to write tapes or to teleprocess AMA data.

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(3) For the tape option, one tape can be written per hour with 12,400 AMA data blocks on each tape (2,048 bytes per block).

(4) For the teleprocessing option, the efficiency of the 4,800, 9,600, and 56 Kbps data links are 90, 90, and 80 percent, respectively.

CONFIGURATION	DAILY VOLUME (MB)
Single Stream	< 203
Dual Stream	> 203

Table 8.4-2 illustrate the teleprocessing options for single and dual stream configurations.

Table 8.4-2 Teleprocessing Options

STREAMS	DATA LINK	DAILY VOLUME (MB)
Single	4,800 bps	< 15.5
	9,600 bps	< 31.1
	56,000 bps	< 161
Dual	4,800 bps	< 31.1
	9,600 bps	< 62.2

8.4.2.4 SCSI Feature Engineering

The SCSI feature impacts disk engineering as follows:

- The SCSI drives are mounted in 21-inch cabinets, rather than in the 30-inch cabinets occupied by the 340-MB drives. Because of this reason, SCSI drives cannot be mixed with the current 340-MB drives in the same cabinet.
- The AM supports SCSI drives.
- The AM must be equipped with either one or two pair of SCSI disk file controllers (DFC) or host adapters. Each DFC hosts two SCSI buses, attaching up to four SCSI disk drivers per bus. The DFC for the SCSI disks is different hardware than that used by the 340-MB drives.
- All drives in a DFC are in the same frame. Each SCSI frame can contain two DFCs.

The following circuit packs are required for each SCSI DFC:

- Two host adapter circuit packs: UN294 and TN2116
- One duplex dual serial bus selector pack: TN69B
- One power converter: 410AB
- One power control circuit pack: TN6B.

The reduction in cost per MB as well as a savings in floor space, makes new applications and growth instances reason to consider SCSI disk drives. There may be cases where growth of SMD disks for an existing office may be desirable inasmuch as SCSI and SMD disks cannot be mixed in the same cabinet. In such cases, there may be a savings in the cost of a new cabinet that may mandate growing SMD disks in the existing cabinet.

8.4.2.5 5E10 and Later Software Releases

As in earlier software releases, optional disks may be added to supplement the base configuration capacities for AMA and SM ODD. Tables 8.4-3 and 8.4-4 show the disk layouts available for the optional

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disk pairs. Optional disk layouts are supported for both the 340 MB SMD, 322 MB SCSI, and the 600 MB SCSI disk drives. The choice of option 2 disks has been expanded from one to three layouts for each disk type. The two additional layouts allow for a finer granularity of the AMA/SM ODD mix (25-75 percent or 75-25 percent split). However, existing offices may use the disk growth procedures to grow optional disk pairs using any of the optional layouts provided.

Table 8.4-3 5E10 and Later Optional Disk Capacities

OPTION		SMODD (MB)	AMA (MB)	PERCENT SMODD	PERCENT AMA
1	0300	0	264	0	100
2	0325	62	192	25	75
	0350	126	128	50	50
	0375	190	64	75	25
3	03100	254	0	100	0
1	0600	0	576	0	100
2	0625	134	432	25	75
	0650	278	288	50	50
	0675	422	144	75	25
3	06100	502	0	100	0

Table 8.4-4 5E10 and Later 1GB Disk Capacities

OPTION		SMODD (MB)	AMA (MB)	PERCENT SMODD	PERCENT AMA
-	0100	0	1001	0	100
-	01025	62	192	25	75
-	01050	490	500	50	50

The AM supports up to 32 SCSI drives. Each pair of SCSI DFCs support a maximum of 16 SCSI disks. The AM does not support a mixed SMD/SCSI configuration, but the maximum number of drives supported with a mixed configuration is 8 pairs, or 16 disks. The AM no longer supports a pure SMD configuration inasmuch as the 600 MB SCSI system disks are required for 5E8. Optional backup disks (drives 14 and 15) are reserved as software backup disks and must be 600 MB SCSI drives. Growth jobs for other than disk pairs 0/1 and 14/15 have the option of using existing 322 MB SCSI or 340 MB SMD drives or of ordering 600 MB SCSI drives. However, when reconfiguring the office, the 600 MB SCSI drives must come first, followed by 322 MB SCSI drives, and finally 340 MB SMD drives.

8.4.2.5.1 Disk Configurations for 3B21D

The 3B21D supports one type of disk interface: the SCSI (Small Computer System Interface) disk drives. There is one type of SCSI drive. The 1GB SCSI drives (formatted as 1GB "1000").

- The base is a "1010" for two 1 GB disk pairs.
- Optional pairs of "10" have a choice in how they are partitioned between SM ODD and AMA. There are five choices for the 3B20D. There are three choices for the 3B21D.
- The 3B21D can support up to seven pairs of disk drives plus two software backup disks.
- The SCSI drive is a circuit pack that must be mounted in the circuit pack rack. It is not a stand-alone unit.

8.4.2.6 AMA Disk Storage Algorithm

How many:

A. local circuit-switched AMA records are generated /day?

B. toll circuit-switched AMA records are generated /day?

C. packet-switched AMA records are generated per day?

D. LASS SCA/CAR AMA records are generated per day?

E. other LASS type AMA records are generated per day?

F. average number of billable ASP/LNP queries per call per day?

G. days of AMA disk storage are required?

Total MB of disk storage =

G * (48*A + 64*B + 74*C + 106*D + 80*E + 61*F) / 1048576

NOTE: LASS = Local Area Signaling Services

SCA = Selective Call Acceptance

CAR = Computer Access Restriction

ASP = Advanced Services Platform

LNP = Local Number Portability

8.4.3 ASSIGNMENT GUIDELINES

Assignment practices that tend to minimize AM/CMP ODD do not necessarily result in a savings of disk space because a fixed amount of space is provided. However, SM assignments that minimize SM ODD do result in more efficient use of disk facilities. The SM ODD disk partition contains the total of all SM and RSM ODDs in the office.

In both SMD and SCSI configurations, drives 14 and 15 are reserved for the simplex software backup disks, which are optional. Backup disk drives 14/15 must be the same hardware as disk drives 0/1. SCSI disk drives 0/1 cannot be mixed with SMD disk drives 14/15. SMD disk drives 0/1 cannot be mixed with SCSI disk drives 14/15. SCSI/SMD indicates that the SCSI disk drives are disk pairs 0/1 and SMD disk drives are configured in the other disk pairs.

Dual stream AMA is supported on all MHD pair, 0/1 through 30/31, except drives 14 and 15.

Backup of nonredundant, static SM ODD is restricted to drive pairs 2/3 through 12/13 as in earlier software

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releases.

The SCSI drives are duplexed across DFCs 0 and 1 or across DFCs 2 and 3. For example, device 0 on bus 0 of DFC matches device 0 of bus 0 on DFC 1, to comprise drive pair 0/1.

8.4.3.1 Feature Impact

The implementation of features or the assignment of features to individuals or groups has an impact on disk facilities. This requires additional ODD space for those lines or groups. For further details, refer to the Feature Impact and Memory Management sections associated with SM and AM memory. Sections 10.3 and 8.2 .

8.4.4 MEMORY MANAGEMENT

NOTE: Traffic count AMAMEM collects the total number of AMA bytes per SM per 1/2 hour. Refer to TRFC30 Section 122 for additional information.

The AMA space on the disk may be monitored to assist in the management of the available disk space. A command (OP:AMA:DISK) may be entered from the MCC to initiate a report showing the percentage of AMA space used. In addition, automatic alarms are activated when the AMA disk area is 70 percent full, 90 percent full, and 100 percent full. When the AMA space is 100 percent full, a critical alarm is activated. If the critical alarm occurs, the AMA buffer in the switch can contain an additional 2,000 to 3,000 AMA records. It is recommended that the HOC be contacted after the first alarm (70 percent full) and requested to poll the switch for the data. Otherwise, an AMA tape must be mounted to store the data so that it is not lost.

All SM and RSM static ODD memory must be backed up on the disk. To determine the current SM ODD size on disk backup (actual pages), use the command OP:STATUS:FREEDISK. You must know the current software configuration (base + optional pairs). To obtain the current configuration, dump a VTOC using the command DUMP:MHD=n:VTOC.

Look at the output from the command. Find all lines that start with:
/no5odd/smdata[n]/dev/no5sodd[n]: = xxxxx blocks.

The base configuration has the lowest number [n]. Additional disks are the lines with [n + 1]. Convert the blocks to MB by dividing blocks by 2,048. Do the conversion for each line. Add the MB. This results in the total MB of free space that can be used. Next figure the current capacity of the disk drives

Lucent Technologies recommends that 10 percent remain unused for growth purposes; disk growth and reconfiguration should be considered when less than 10 percent is available. Each of the base configurations contains one SM ODD backup partition. All optional disk layouts except those consisting of 100 percent AMA, also contain SM ODD backup.

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8.5 COMMON NETWORK INTERFACE RING

8.5.1 Overview

The Common Network Interface (CNI) is a packet-switching system used for switching signaling messages in the Common Channel Signaling (CCS) network. The CNI ring hardware is implemented in a single equipment bay in the *5ESS*® switch and connects to the AM via a Dual Serial Channel (DSCH) interface.. Refer to 235-200-150 *CNI Common Channel Signaling* for a full description of the CNI hardware.

8.5.2 ENGINEERING CONSIDERATIONS

8.5.2.1 CNI Frame Layout Rules

The following are the basic rules for equipping a IRN2 CNI ring in a *5ESS* ® switch:

(1) Only one CNI cabinet is used.

(2) RPCNs must be in groups 00 and 32 and only in position 0.

(3) LNs can be in the following positions:

- positions 1, 3, and 4 in groups 00 and 32.
- positions 1 through 8 in groups 01, 02, 33, and 34

(4) LNs must be 56 kbps non-encrypted.

(5) Groups 00 and 32 must be filled before groups 01 and 33 can be equipped.

(6) Groups 01 and 33 must be filled before groups 02 and 34 can be equipped.

(7) All nodes must be grown from right to left on each shelf.

(8) DLN/DLN30s, if equipped, must be in node position 2 of each service group.

8.5.2.2 Sizing the Ring for Office Traffic Load

Choosing the correct number of link nodes to be equipped on a CNI ring depends on the office traffic load. The office traffic load will consist of call connections as well as connectionless feature traffic.

A 56 Kbps signaling link pair should be engineered so that each link in the pair is normally loaded to 40 percent capacity. This practices ensure that a single link can carry all normal traffic and have reserve capacity for peaking should the mate link fail.

Use of IRN2 nodes, increases the link pair capacity to 19 pair. Table 8.5-1 shows the maximum engineered capacities for different link equipages.

Table 8.5-1 Maximum Engineered Link Pair Capacity

LINK PAIRS EQUIPPED	ENGINEERED CAPACITY (Kbps)
1	44.8
2	89.6
3	134.4
4	179.2
5	224.0
6	268.8
7	313.6
8	358.4
9	403.2

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10	448.0
11	492.8
12	537.6
13	582.4
14	627.2
15	672.0
16	716.8
17	761.6
18	806.4
19	851.2

Link provisioning should be done using projected end-of-period peak hour loads. Provisioning in this way assumes that the call traffic or feature traffic has a steady arrival rate throughout the hour. If the service provider engineer is aware of sudden bursts (load spikes) of heavy signaling traffic, link provisioning should be adjusted accordingly.

8.5.2.3 Monitoring Link Traffic Load

8.5.2.3.1 Overview of Monitoring Link Traffic Load

Once the ring is sized, the capacity of the links and the link nodes must be monitored. This can be accomplished by calculating the link node capacity. The following equation provides a means of achieving this:

Figure 8.5-1 Link Node Capacity Worksheet

This equation determines the maximum number of messages per second that can be handled by a small scale integration (SSI) link node. The following steps solve the equation. Figure 8.5-1 is the worksheet for recording the result of the following steps.

(1) **Calculating Real Time** - The value to use in the equation for *percent real time* is 78. The percentage of link node real time is always 78 for link node type of SSI used in the CNI ring of an SSP (SS7 office).

This makes the numerator of the equation equal to 780 ms. This is derived from (78 □ 100) □ 1000 (converting to ms).

(2) **Determining the Message Type(s) and Traffic Mix(es)** - The message type(s) is denoted by the letter ``i'' in the equation. It is possible to have one or more message types arriving in the SSI link node. This means that there can be more than one ``i'' in the equation. Contact your traffic engineer or planning/marketing staff member to identify the message type information for your office. The following data are required:

- □ The types of messages that may arrive at the link node for routing and screening
- □ Whether the message type has screening flag ON or OFF
- □ Whether the message is linkbound, ringbound or bidirectional
- □ The fraction of the traffic mix each message is to provide
- □ The average message size.

This information can be entered on the *Link Node Capacity Worksheet* in Figure 8.5-1 . The traffic

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or planning engineer can fill in columns A, B, C, and D. Potential types of messages and directions are shown on the worksheet in Table 8.5-2 *Processing Times Per Message in the SSI Link Node*. For every message type, ``i'', there is a percentage of the traffic, ``M'', that it will provide.

NOTE: The sum of all ``M''s must equal 1.

(3) **Determine the Processing Time(s)** - From Table 8.5-2 , find the processing time for each type of message and its direction. The time value for each message equates to a ``T'' in the equation. Place this information on the worksheet in column E.

Figure 8.5-2 Link Node Capacity Worksheet

Table 8.5-2 Processing Time Per Message in the SSI Link Node

A	B	C	D	E	F
NO.	**MESSAGE TYPE**	**SCREENING FLAG**	**LINKBOUND PROCESSING PER MESSAGE (ms)**	**RINGBOUND PROCESSING PER MESSAGE (ms)**	**BI-DIRECTIONAL LINK NODE PROCESSING (ms)**
1	SCCP PC ROUTED	OFF	1.07	2.06	3.13
2	SCCP PC ROUTED	ON	1.06	4.21	5.27
3	MTP ISUP	OFF	1.01	2.20	3.21
4	MTP ISUP	ON	1.01	3.80	4.81

(4) **Solving the Equation for Link Node Capacity** - At this point, the numerator of the equation equals 780 and the denominator,

SUM ($T_i \square M_i$)

can be rewritten as:

SUM ($T_{\text{message type i}} \square M_{\text{message type i}}$)

which means:

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(Processing time of message type 1 □ Traffic mix of message type 1) +

(Processing time of message type 2 □ Traffic mix of message type 2) +

(Processing time of message type 3 □ Traffic mix of message type 4) + ... +

(Processing time of message type n □ Traffic mix of message type n).

Based on the worksheet, every message type traffic mix in column D should be multiplied by the processing time in column E and the results should be entered in column F.

Total columns D and F. Column D must total 100 percent or 1.00. Column F total is the denominator of the equation. Divide the numerator by the denominator to determine the number of messages that the link node can handle per second or the link node throughput.

(5) **Analyzing the Result** - Using the *SS7 Link Throughput* graph (Figure 8.5-3) plot the average message size obtained from engineering on the horizontal axis and the link node throughput (number of messages the link node can handle per second from the previous step) on the vertical axis, and find the intersection of the two. This intersection is the estimated capacity of the link within 5 capacity curves, under linkset failure conditions.

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Figure 8.5-3 SS7 Link Throughput

8.5.2.3.2 Example of Monitoring Link Traffic Load

As an example, a SSI link node expected to process a bidirectional traffic mix consisting of 20 percent MTP ISUP messages and 80 percent SCCP GTT messages, with all messages requiring screening (screening is ON), is estimated by the following:

NOTE: Figure 8.5-4 is the worksheet for this example.

(1) **Calculating Real Time** - Because this is an SSI link node, the numerator equals 780. At this point, the equation looks like:

Figure 8.5-4 Example of Using the Link Node Capacity Worksheet

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(2) **Determining the ``i''s (Message Types) and ``M''s (Traffic Mixes)** - The traffic engineer or planning/marketing person should provide the following:

- There are two ``i''s or message types in this equation: Message type 1 is bidirectional MTP ISUP with screening flag ON
  Message type 1 is bidirectional SCCP GTT with screening flag ON

- There are two ``M''s or traffic mix percentages in this equation: For message type 1, the MTP ISUP message, the ``M'' is .20
  For message type 2, the SCCP GTT message, the ``M'' is .80

  NOTE: The addition of the ``M''s in this equation equals 1.00.

(3) **Determining the ``T''s or Processing Times** - There are two ``T''s or processing times in this equation. One is for each message type. To determine the value for these ``T''s, consult Table 8.5-2 . The processing time for message type 1, a bi-directions MTP ISUP, is 4.81. The processing time for message type 2, a bidirectional SCCP GTT, is 5.02.

Figure 8.5-5 Example of Using the Link Node Capacity Worksheet

(4) **Complete the Denominator of the Equation** -

- For the message type 1, MTP ISUP, multiply column D by column E. In this instance: .20 □ 4.81. The result of this, .96, is entered in column F. This represents the processing time required for MTP ISUP message.

- For the message type 2, SCCP GTT, multiply column D by column E. Similarly, in this instance: .80 □ 5.02. The result, 4.01, is entered in column F. This represents the processing time required for SCCP GTT message.

- Add the processing times of the MTP ISUP and SCCP GTT messages. This is .96 + 4.01 or a total of 4.97. Enter this at the bottom of column F. The equation looks like:

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(5) **Solving the Equation for Link Node Capacity** - The numerator divided by the denominator gives a result of 156.94

LN_CAP = 156.94

With this combination of messages the link node can handle 156.94 messages per second or link node throughput.

(6) **Analyzing the Result** - Using the *SS7 Link Throughput* graph, plot the average message size obtained from engineering on the horizontal axis and the link node throughput, obtained from the above calculation, on the vertical axis. Find the intersection of these two. This intersection represents the estimated capacity of the link within the five capacity curves, under linkset failure conditions.

- If the average message size is greater than 30 bytes, the linkset is operating above capacity.
- If the average message size is less than 30 bytes, the linkset is operating below capacity.

8.5.3 OVERLOAD CONTROL FOR CCS CALLS

In network traffic management (NTM), the functions are to monitor the traffic in the network in real time and to activate controls to correct network traffic flow problems. The objective is to complete as many calls as possible and to keep the network operating near maximum efficiency. Network traffic overload in a properly engineered network is caused by unusual customer demands or network equipment malfunction.

Real time NTM measurements, used by the network traffic manager, includes status and event discrete indicators and 5-minute NTM measurements. These measurements are collected from the switching systems by a NTM Operations System. However, another method of monitoring the level of congestion is to study the switch congestion failures (SWCONG), unsuccessful attempts (TOTAL UNSUCC ATTEMPTS), no circuit available (No Circuit Available) counts in TRFC30 Section 120.

8.5.4 OVERLOAD CONTROL FOR DLN

The call capacity of the *5ESS*® switch has increased over time because of three main enhancements;

(1) Addition of the communication module processor (CMP)

(2) Deployment of common channel signaling (CCS) in the local exchange carrier (LEC) networks for the support of the Custom Local Area Signaling Service (CLASS).

(3) Introduction of CCS network interchange which changed the signaling from multifrequency to CCS in the IEC-LEC network.

The DLN Overload Control capability is introduced to better handle the sustained CCS overloads occurring in the LEC and IEC networks.

8.5.4.1 Description

The DLN overload control capability enables the *5ESS*® switch to better handle sustained CCS overloads occurring in the LEC and IEC networks. Two principal areas of concern for the overload control involve the

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resource overload controls (congestion controls) and real-time overload controls. The DLN overload control capability:

- Adds a 3-level overload control for the DLN
- Keeps the current 3-level incoming congestion controls
- Adds 2-level outgoing congestion controls
- Adds call failure handling for PIC and SMP overloads
- Adds new counts to the TRFC30 report
- Connects DLN overloads to the central *5ESS*® switch overload control.

The overload control mechanism checks for DLN overload every six seconds. When a real-time overload is detected in the DLN, the overload mechanism initiates controls to automatically return the system to a normal state and issues an overload report at the ROP or MCC. A real-time minor overload occurs because of message delays in the DLN. At this time, the automatic congestion control level 1 requests the sending switch to reduce the number of CCS call originations by implementing CCS avoidance routing. The overload control throttles low priority messages in an attempt to reduce the buffer occupancies. If the condition worsens to a major overload, the automatic congestion control level 2 is set and another message is sent to the sending switch to reduce call traffic. In addition, 100 percent CCS avoidance routing activates in the CMP to eliminate any new CCS originations until the overload condition subsides.

8.5.4.2 SS7 Capacity Improvement DLN30

The SS7 Capacity Improvement DLN30 feature increases the *5ESS*® switch SS7 call processing capacity. This feature requires a DLN-AP30 replacement for a DLN-AP and a conversion from a Small Scale Integration (SSI) based technology to Integrated Ring Node Version 2 (IRN2) for all the CNI nodes, Link Nodes (LNs) and Ring Peripheral Controller Nodes (RPCNs). It also requires new IRN2 shelves.

This feature supports the following hardware upgrades to the CNI ring:

- The DLN application processor was replaced with the HC *MOTOROLA*® 68030 This change requires that the DLN's SSI based ring interface also be replaced with the IRN2 Technology. The IRN2 Technology is necessary for the DLN to deliver the required performance. The AP-30 is only available with the IRN2 technology.
- The new AP-30 hardware grows the DLN memory from the existing 2 MB to 16 MB. This memory is not engineerable.
- The upgrade of the SSI-RPCN to IRN2 technology.
- The upgrade of the SSI-LN to IRN2 technology
- Two new shelves are required for this feature. They are J3F011GD-1 and J3F011GC-1. The J3F011GD-1 can be equipped with an RPCN, DLN30, and three LNs. The J3F011GC-1 can be equipped with up to eight LNs.
- A total of six groups are available with IRN2. They are 00/32, 01/33 and 02/34. Each group pair must be identically equipped.

These hardware upgrades:

- Increase the SS7 message handling capacity of the CNI ring.

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- Increase the number of SS7 link terminations from 5 to 19 pairs by using the IRN2 technology and a new IRN2 shelf arrangement to link pairs.
- Increase the DLN memory, which results in an increase in trunk translation data allocation in the DLN.
- Grows the maximum DLN memory from the existing 2 MB for the SSI DLN to 16 MB for the DLN30. The additional memory supports 100,000 SS7 trunks and new features.
- Increases the DLN30 internal call capacity from 280,000 call/hr to 750,000 calls/hr.

TRFC30 Section 66 is used to determine when to replace a DLN with a DLN30. Replace the DLN with a DLN30 when occupancy reaches 80 percent or more. Refer to 2.3.1.9 for the latest feature impact on TRFC30 Section 66.

It is necessary to replace a DLN with a DLN30 when more than 30,000 SS7 trunks are required per office. In an office, all ring hardware must be the same type. Mixing of SSI and IRN2 technologies is not allowed, except when converting from SSI to IRN2.

8.5.4.3 E-Link Access

The E-Link connects the SS7 signaling links between Signaling End Points (SEP) and non-Home Signaling Transfer Points (STP). From an end office perspective, a non-Home STP pair is any STP pair other than the pair on which the A-Link terminates for that end office. The destination of the A-Links identifies the home STP pair. A benefit of E-Link Access appears in networks requiring all global title translation to be performed in a specified non-Home STP pair.

The E-Link Access provides:

- ***Improved survivability*** - Provides additional routes to destinations to further minimize SEP isolation. E-Link sets serve as alternate routes in the event of failed A-Link sets.
- ***Direct message routing*** - May be used to allow traffic study to be directly routed to other STP pairs or quads from SEPs to use fewer intermediate STPs. This speeds up call processing and improves network performance.

8.5.4.3.1 Feature Loading

"E" and "A" links coexist in the same Common Network Interface (CNI) frame at the end office. The destination of the link and database translations determines whether a link is designated as "A" or "E". "A-Links" and "E-Links" use the same node hardware as other Lucent signaling products. "E-Links" use the same types and quantities of node hardware as do the "A-Links".

8.5.4.3.2 Feature Assignment

"E-Links" are paired; one link to the active (non-HOME) STP and the other link to the active (non-HOME) STP's mate. Load sharing occurs between the two links of the pair (exactly as with "A-Links").

This feature allows the assignment of both an alternate route and a secondary alternate route. If the primary route should become unavailable, its signaling load is acquired by the alternate route. If the primary and alternate route both become unavailable, then signaling load is directed to the secondary alternate route. The primary, alternate, and secondary alternate routes should be assigned to different STP pair.

NOTE: One combine "E-Link" set can serve as an alternate route for another combined "E-Link" set.

The "E/A-Link feature" package does not require unique hardware, as it is a software (logical) feature.

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Equipage of this feature requires more link node hardware.

Lucent Technologies recommendeds that "E-Links" be engineered to 40% of maximum loading, the same as "A-links" so that if one link of a pair becomes unavailable, the other link can manage the load. If all links from an end office to an STP pair become unavailable alternate routing is attempted. Alternate routing is not attempted until all links in the combined link set of the PRIMARY route have become unavailable.

The number of "A-Links" should be engineered to handle the entire office signaling load, independent of any direct routing loads on the "E-Links". This is because if all "A- Links" fail, the "E-Links" carry the entire office signaling load. When designing the SS7 network architecture, only one combined "A-Link" set is supported, while 15 combined "E-Link" sets can be supported per end office.

8.5.4.3.3 Measurements/Monitoring

The Signaling Network Performance Report collects and itemizes counts for "E-Link" sets, as it does for "A-Link" sets. All office total counts include the usage on "E-Links". A measurement of alternate routing occurrences and duration is reported per link set. All reports are transmitted to their current interfaces.

The 30 Minute Marginal Performance report is also modified to support the "E/A-Link feature".

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9. CM RESOURCE UTILIZATION

This section provides information for administering the *5ESS*® switch and the *5ESS*® switch Compact Digital Exchange (CDX) Communication Module (CM). CM administration does not apply to the Very Compact Digital Exchange (VCDX) switching system. For more information, refer to 235-120-110 □ *Very Compact Digital Exchange (VCDX) Reference Guide*. The assumption is that the reader has a basic knowledge of the *5ESS*® switch architecture and operations. The following subsections provide resource utilization information on a physical group basis. Refer to the table of contents at the beginning of each subsection for a complete description of the information included. Each subsection provides information to administer the particular resource. The following subject areas are included:

- □ Module Message Processor (MMP)
- □ Message Switch Control Unit (MSCU)
- □ Communication Module Processor (CMP).

COMMUNICATION MODULE

The CM is the central hub of the switching system. All interprocessor voice, data, and system messages pass through the CM. The CM includes the time multiplex switch (TMS) and the message switch (MSGS). The CM is connected to the switching module (SMs) by way of the network control and timing (NCT) links. The SM-2000 is connected to the CM via the NCT2 links.

The MSGS provides connections for messages between processors [SM-to-SM, SM-to-administrative module (AM), AM-to-SM, SM-to-foundation peripheral controller (FPC), etc.]. The MSGS consists of an MSCU and several MMPs. The MMP is an interface to the NCT link connecting the MSGS and the SM. The MSCU is used to route control time slot to the proper SM or the AM. The MSCU contains input/output microprocessing interface (IOMI) boards. The IOMI provides the interface between the peripheral interface controller (PIC) and peripheral controller subsystem (PC). There are:

(1) A maximum of 4 IOMI circuit packs per MSCU2

(2) Four IOMI communities per IOMI circuit pack

(3) Four PCs per IOMI community

(4) A maximum of 64 PCs per MSCU2.

COMMUNICATION MODULE 2

The new start offices have the option of using the MSCU3 in the CM2. The Communication Module 2 (CM2) requires the MSCU3. The MSCU3 has a new circuit pack, the Input-Output Processor Model 2/Message Switch Controller Model 3 (IOP2/MSC3). This pack combines the functionality of the Peripheral Interface Controller (PIC2), the Bus Interface Controller (BIC), the Duplex Dual Serial Bus Selector (DDSBS), the Pumpable Micro Control Store (PMCS), and the first IOMI pack (IOMI-A) onto one board. All four IOMI-A buses can terminate on IOP/MSC3. Besides the IOP/MSC3 circuit pack, a new backplane for MSCU3 is necessary. No other packs, units or cables are affected.

Two message switch peripheral units are in the CM1: the FPC providing control and diagnostic messages to the office network timing control (ONTC) units, and the pump peripheral controller (PPC) which enables the AM to fast pump the SMs during initialization. CM1 also has the message interface clock unit (MICU). The MICU converts the MSGS to the TMS.

Each MMP has ports for up to eight message links to SMs. In the CM1 version, each SM is connected through message links to four different MMPs, two on each MSGS side. Thus, each MSGS side requires a

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minimum of two MMPs for every eight SMs, or fractions thereof. If required, expansion to 12 MMPs per MSGS side is possible. Two MMPs per MSGS are possible for the CM2C.

The structures of the processors in the MSGS allow the processor occupancies to be inferred from the frequencies at which the base level cycles (BLCs) are executed. The numbers of executed BLCs as well as the number of messages handled, are counted for each MMP in the CM.

The loads on the MSGS components are expressed in terms of messages handled per unit of time. The occupancies and BLC frequencies of MSGS components are approximately linearly related to the load. As the load increases, the occupancy increases and the BLC frequency decreases. A regression of the observed message loads against the corresponding observed numbers of BLCs allow an estimate to be computed for the message load that theoretically results in 100 percent occupancy. The capacity estimate is then determined as a specified fraction of this 100 percent occupancy load. These capacity estimates are then provided on the central office equipment report (COER) reports and may be used to judge the adequacy of the MSGS components at current and projected loads.

The *5ESS*® switch capacity is not limited by the MSGS, which has a capacity that greatly exceeds 300,000 calls per hour (5,500,000 messages). The MMP capacity is approximately 1,200,000 messages per hour, far above the expected peak load.

The CM2 is composed of a Time Multiplex Switch 2 (TMS2) and a MSGS2 providing a greater call capacity for the switch and permitting a more compact physical design.

The time multiplexed switch - model 2 (TMSU2) is a dual 256 by 256 switch (compared to a 32 by 32 switch in TMS1). An option allows the TMS2 to be equipped as a single-fabric 256 by 256 switch. The number of host and local SMs (requiring a control time slot) which can be supported is 94 for the single-fabric configuration and 190 for the dual-fabric configuration. If at least two RSMs are included, 96 and 192 modules, respectively, can be supported. The CM2C supports only two local or host SMs and six RSMs.

The TMS2 is used to switch like numbered NCTs between SMs to allow for inter-SM calls. Except for the CM2C, the TMS2 can support single and dual fabric switching:

- A single fabric CM2 can consist of from two to six cabinets on both sides combined and can support a maximum of 96 SMs. Not more than two of the SMs can be RSMs (except for the CM2C, as noted previously).

- A dual fabric CM2 can consist of from 2 to 12 cabinets on both sides combined and can support a maximum of 192 SMs. Not more than two of the SMs can be RSMs. The CM2C does not support dual switching fabric.

NOTE: The type of fabric is determined when the office is originally engineered. However, conversion from single fabric to dual fabric is also supported.

The message switch peripheral unit - model 3 (MSPU3) is an enhancement of the MSPU1 and MSPU2 designs. It includes the MMPs. In CM1 each MMP contains four boards: processor pack, control pack, and two high-level data link controllers (HDLC). The enhancement not only reduced the software required for message handling but also reduced the required real time per message.

The Time Multiplexed Switch Unit 3 (TMSU3), from 5E6 and later, supports the CM fabric reduction. This reduction replaces two fabric controller packs and up to three fabric packs with one fabric circuit pack. Configuration requirements for TMSU3s and TMSU2s in a CM2 cabinet are as follows:

- TMSU3 is used for all new office ships and for all existing office growth.

- The TMSU3 can be used for both single and dual fabric applications.

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- TMSU Shelves 0 and 1 in both base bays (Bays 5 and 6) must be the same vintage. Either TMSU2 or TMSU3 will work as long as both shelves in both bays are identical. This rule applies to both single as well as dual fabric applications. After satisfying this requirement, growth can be completed with either TMSU2 or TMSU3 in any combination.

In addition to other enhancements, the message switch control unit - model 2 (MSCU2) can support up to 24 parent-frame MMPs and 24 growth-frame MMPs. The 48 MMPs can support up to 192 SMs.

COMPACT COMMUNICATION MODULE 2

The CM2C is a reduced cost CM2 introduced with the *5ESS*® switch Compact Digital Exchange (CDX) . The CM2C interfaces a maximum of two Local or Host SMs and up to six RSMs. One of the SMs may be an SM-2000]. A maximum of two MMPs per side and three Network Clock external references are supported. The time multiplex switch (TMS) supports up to four NCT links (TMSLNKs) in a single fabric environment. The CM2C is packaged on one shelf per side and is powered by a single power converter. The CMPs occupy a separate shelf.

COMMUNICATION MODULE 3

The CM3 is functionally equivalent to the CM2 and support all existing interfaces and functionality of the CM2 except for the following differences where CM2 supported a functionality that CM3 does not:

(1) CM3 only supports the dual-fabric TMS configuration, whereas CM2 supported both the single-fabric and dual-fabric configuration.

(2) CM3 only supports the quad-MMP configuration, whereas CM2 supported both dual and quad-MMP configurations.

(3) CM3 only supports the Stratum 2 Oscillator type, whereas CM2 supported four oscillator types.

(4) CM3 does not support DLN or CCS off of the AM CNI ring, whereas CM2 supported DLN and CCS from the AM.

(5) CM3 will have different floor plan, unit layout and pack TLP locations than CM2

(6) CM3 may have different MCC pages or MCC page layouts than the CM2

(7) CM3 may have different craft interfaces (commands/pokes) than CM2

(8) CM3 terminates many CM scan/distribute points within itself. CM alarm detecting/reporting functionality currently provided by RTR software/hardware (IOP scan points) is moved to 5ESS software/hardware. Only 4 IOP scan points are connected to the AM IOP and remain under RTR control

(9) CM3 circuit packs contain only an Out-of-Service (OOS) indicator. Request OOS, Restore, and Manual Override switches, and request-in-progress status lamps are not used in CM3

(10) CM3 always supports QGP and QLPS on TMS fabric ports 188-191, whereas in CM2, QGP and QLPS were optional and growable and QLPS could be equipped at any TMS fabric QLI location.

(11) CM3 supports a single MMP for 192 even CLNK control timeslots and a single MMP for 192 odd control timeslots (per side), whereas CM2 supported up to 24 even and 24 odd MMPs each handling 8 CLN control timeslots (per side), where each MMP could be individually grown, removed, restored, and diagnosed.

(12) In CM3 only the MSGS is diagnosed, whereas in CM2, the MSCU, FPC, FPC, QGP, PPC, and CMP could be individually diagnosed.

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(13) In CM3 only the MSCU and CMP are pumpable during a restore, whereas in CM2, the MSCU, CMP, FPC, MMP, QGP, and PPC were pumpable during a restore.

(14) In CM3 the ONTC-AP and ONTC-IP are pumpable during a restore, whereas in CM2, the ONTC was not pumpable.

(15) CM3 supports a hardware check inhibit/allow on only the enitre MSGS complex, whereas CM2 supported individual hardware check inhibit/allows for the MSCU, FPC, MMP, PPC, QGP, and CMP.

The following CM2 functionalities are also provided for CM3:

- Dual Serial Channel Interface to the Administrative Module (AM)
- Network Clock Distribution Function
- NCT2/NCT1 Link Interconnections to SM-2000s/ SMs
- Time Multiplex Switch (TMS) Controller Functionality
- NCT Link Control Time Slot Processing
- Central Processor Intervention (CPI) to the SM-2000s & SMs for Low-Level Reset and Hardware Control
- Message Switch Functionality for 192 Odd and 192 Even 48 Kb/s Control Timeslots between the AM and All Other Messaging Endpoints
- Communications Module Processor (CMP) Functionality
- Quad Link Packet Switch (QLPS) Functionality for Packet Switching of Message Pipes from the SM-2000 Message Handlers
- QLPS to AM or QLPS to Message Switch Interconnectivity Similar to the QLPS Gateway Processor (QGP) Function
- 32 Timeslot Pump Capability to the SM-2000s Similar to the Pump Peripheral Controller (PPC) Circuit on CM2

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9.1 MODULE MESSAGE PROCESSOR

9.1.1 DESCRIPTION

9.1.1.1 General

The module message processors (MMPs) provided in communications module model 2 (CM2) function in a manner similar to those provided in CM1.

Each MMP consists of a 2-circuit pack design (different from the ones used in CM1) equipped in the message switch peripheral unit 3 (MSPU3). The MMPs provide communication links between the switching modules (SMs) and administration module (AM). The MMPs control the sending and receiving of messages and also administer the link-level protocol for messages sent to and from the SM processors. Each MMP supports up to eight fixed time slot channels for messages from up to eight SMs; therefore, to determine the number of MMPs, divide the number of SMs in the office by 8 and round up. The CM2 can be equipped with up to 48 MMPs in 8 MSPU3s to support communications between the AM and up to 192 SMs.

With the CM2 offices, single MMPs are equipped per side. The single MMP provides two communication link terminations per SM [one per message switch (MSGS) side]. The MSPU can be equipped with optional dual MMPs. The dual MMP provides four communication link terminations per SM as in CM1.

9.1.1.2 Optional Dual Message Module Processor

The dual MMPs consist of the two existing MMPs: one each in MSG0 and MSG1, plus two additional MMPs, one each in MSG0 and MSG1. Each of the additional MMPs are of the type to be grown on two new separate communities of MMPs, one on each MSCU side. The additional MMPs are equipped on the right half of the existing MMP shelf. Besides the two additional communities and the additional two MMPs, a new control and display (C&D) pack, a new power pack, and additional cabling are needed to grow dual MMPs.

If one SM in a single MMP configuration is grown to dual MMP, it is recommended that the rest of the SMs on the same single MMPs be grown to dual also.

9.1.1.2.1 Single to Dual MMP Growth

Dual MMPs are of the same type as the existing MMPs and the same growth procedures are used in growing dual MMPs as used for single MMPs. The existing recent change views are used for this growth.

The optional dual message module processor (DMMP) feature provides reliability of full message transfer capacity over both active communication links in CM2 equipped offices. The DMMP is not a new hardware unit. Rather, this optional feature allows equipage of more hardware to provide greater reliability.

When CM2 was introduced, MMPs were configured as either "alpha" or "beta." Alpha MMPs processed only alpha control time-slots and beta MMPs processed only beta control time-slots. Alpha control time-slots are even numbered below the 96th SM and odd numbered above the 96 th SM. Beta control time-slots are odd numbered below the 96 th SM and even numbered above the 96th SM. For the standard CM2 configuration 2 MMPs work as an alpha/beta pair. For example, of the alpha/beta MMP pair for SM 1 through SM 8, the alpha MMP processes even numbered control time-slots for SM 1 through SM 8, while the beta MMP processes the odd numbered control time-slots for SM 1 through SM 8.

In a CM2 office, if maintenance actions remove an MMP from service, some messaging capacity is lost. During such events, the remaining MMP of the alpha/beta associated pair is required to handle the full messaging load. For normal plain old telephone service (POTS) SMs, if one half of the alpha/beta pair is removed from service, message traffic usually is not great enough to cause service impact (delays). However, integrated services digital network (ISDN) SMs and other SMs that generate high messaging rates may become a concern during simplex operation.

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With the introduction of message intensive features such as ISDN services, local area signaling service (LASS), Advance Services Platform/private virtual network (ASP/PVN), etc. along with the higher call capacity , the message load and the control time slot (CTS) links and the MMP become greater. As a result, the importance of having both an alpha and beta MMP in-service in a CM2 equipped office may be more critical. Therefore, dual MMPs areas an optional feature to provide the capability of CTS link sharing which balances the message load between the CTS links of an SM.

The DMMP is an optional feature to prevent an MMP hardware failure from causing messaging delays (service impact) from high message traffic SMs in a CM2 office. In other words, a DMMP configuration associates 2 alpha and 2 beta MMPs. This mode of operation provides a standby MMP for both the active alpha and beta MMP. Therefore, with dual MMPs, a single MMP fault does not impact call processing because there is still two CTS links per SM to load balance the message traffic.

9.1.1.3 Communications Module Processor

The communications module processor (CMP) is a nonengineerable processor All 5E6 and later offices are equipped with duplicated CMPs requiring 20 MB of memory. The TN1368 core board consists of two 68030 microprocessors and 4 MB of memory. Another memory board (TN1369) provides an additional 16 MB of memory. Approximately 18 MB is required to support text and ODD in 5E8. Of this, 8 MB is a fixed allocation for the ODD.

9.1.2 CAPACITY CONSIDERATIONS

9.1.2.1 CTS MESSAGE OVERLOAD

In normal switch operation, each SM uses two CTSs, with each CTS having a bandwidth of 48 Kbps. This bandwidth is sufficient for most conditions. Some situations exist, however, for which the message load is too large for the CTSs to carry. For these cases, administrators must take steps to reduce the message load on affected SMs.

NOTE: CTS Overload is not a concern for SM-2000s that use the QLPS for messaging.

Two ways exist to discover if an SM's CTSs are at or near overload.

- When the SM has too many message to transmit over the CTS the following message prints on the ROP:

  OP OVERLD SM = xx (Where xx is the SM number)
  REAL TIME NONE
  RESOURCE MSGS
  CONTROLS NONE

- TRFC 30 Section 125 (CTS) shows CTS occupancies for SMs selected by an "ALW" input message at the MCC. This section reports the average occupancy and the maximum occupancy in a 6 second period for each CTS, both transmit and receive, over the previous 30 minute reporting period.

Link occupancies as reported on the TRFC30 Section 125 should not normally exceed the values shown in Table 9.1-1 .

Table 9.1-1 CTS Occupancies and Thresholds

TRFC 30 Section 125	Maximum Occupancy		Recommended Thresholds	
	Average	Peak	Average	Peak
Receive (RCV)	75%	90%	55%	75%
Transmit (XMT)	75%	90%	45%	65%

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Occasionally exceeding these values is acceptable, however if the values are frequently exceeded or if the "OP OVRLD RESOURCE MSGS" occurs, steps should be taken to reduce the message flow to and from the SM having high link occupancy.

If the SM serves as a routing SM, move one or more of the hundreds groups to a less loaded SM. If it is equipped with lines and trunks, moving them off the SM to a different SM may reduce the message load if the call rate for these lines or trunks is large. Both real time (processor occupancy) and CTS occupancy of the destination SM must be investigated to avoid overloading a different SM.

If the SM serves as a hunting SM, the hunting can be moved to a less loaded SM. In the most severe case of extremely high call rates, the hunting may have to be done on an SM dedicated to hunting.

If the SM serves as the host to an AP and also has lines and trunks equipped, move lines and trunks having high call rates to a different SM. Refer to ASSIGNMENT GUIDELINES for more information.

In some cases, redefining the end customer's feature may provide controls on the call rate to the SM with high CTS occupancy or may redistribute the messages. For instance, decreasing the size of an SFG for a terminal group reduces the number of calls and, therefore, the number of messages to the SM doing the hunting for the group.

Some customers may have features that generate intense bursts of call originations or terminations, such as a focused load on an SM. Call-in talk shows and some forms of marketing are examples. For these cases short term load on the CTSs can lead to overload conditions causing lost messages. To avoid this, it may be necessary to impose restrictions on calls to the associated lines or trunks during the times of high call volumes. Network management controls on originating switches such as call gapping or choking can achieve this. Providing the customer with a choice of alternate features may also ease the load on the CTSs during these periods.

9.1.2.2 DETERMINING REQUIREMENTS FOR DUAL MMP

Offices should monitor their message traffic to determine if dual MMPs are needed for any SMs. The specific measurement to monitor is TRFC30 Section 125. This section reports the occupancies of the CTS for each SM during the previous 30-minute reporting period. Refer to 235-600-750 *Output Messages Manual* to view a TRFC30 Section 125 report. The transmit (XMT) quantities are occupancies for the link directions away from the SM, and the receive (RCV) are the quantities for link directions toward the SM.

The quantities reported are:

- Average percentage occupancies for both CTS links for the XMT and RCV directions (4 quantities).
- The maximum percentage occupancy for each link and each direction during a 6-second period (4 quantities).

The following procedure determines if dual MMPs are recommended for a particular SM.

(1) Calculate the sum of the average percent occupancy for the XMT and for the RCV directions.

Summed average XMT occupancy = [0XMT(AV) + 1XMT(AV)]
Summed average RCV occupancy = [0RCV(AV) + 1RCV(AV)]

Calculate the *overall summed average* XMT and RCV occupancies by averaging the above quantities over several (typically 100) busy half-hours.

(2) Determine the 99th percentile value for each of the maximum percent occupancy quantities using only reports from busy half-hours. To obtain an accurate estimate of the 99th percentile value. At least 100 data points for each quantity should be collected. Assuming 10 busy half-hours per day and 5 days per week suggests that 2 weeks of data are needed for this analysis. This analysis

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assumes that both links are being used during the measurement period.

For each link and each direction, calculate the following:

Average peak = Sum (peak value)/ N
Peak variance = Sum ((peak value - average peak)^2)/(N-1)
where: N is the number of observations and
Sum is a sum over these N observations.

The 99th percentile, P99, is:

[redacted]

- Determine the 99th percentile value for the summed maximum percent occupancy using only reports from busy half-hours. As in the previous example, at least 100 data points (about 2 weeks of data) are needed for the analysis. The analysis assumes that both links are being used during the measurement period.
  - Calculate the following summed quantities:
    Summed peak value (XMT) = [0XMT(PEAK) + 1XMT(PEAK)]
    Summed peak value (RCV) = [ORCV(PEAK) + 1RCV(PEAK)]
  - Calculate the 99th percentiles of the summed peak values in both the XMT and the RCV directions as follows:

    Average summed peak = Sum (summed peak value)/ N
    Summed peak variance = Sum ((summed peak value - average summed peak) ^{2})/(N-1)
    where: N is the number of observations and
    Sum is a sum over these N observations.
    The 99th percentile, PSUM99, is:

    [redacted]

- Dual MMPs are recommended for those SMs for which any of the following occur:
  - The summed average XMT occupancy exceeds 58 percent.
  - The summed average RCV occupancy exceeds 45 percent.
  - P99 for either XMT exceeds 46 percent and PSUM for XMT exceeds 81 percent.
  - P99 for either RCV exceeds 32 percent and PSUM for RCV exceeds 58 percent.

Each MMP manages the even or odd control time-slots for 8 SMs. Offices can provision both single MMP and DMMP configurations in the same CM2 or CM2C equipped office.

9.1.3 ENGINEERING CONSIDERATIONS

The capacity of the MMP limits the total of the call processing and maintenance messages processed. The capacity of an MMP with CM2 is 120,000 EQPOTS calls per hour. An MMP may have as many as eight SMs (two SMs for CM2C offices) assigned to it.

The occupancy of the MMP is based on BLCs. As the number of messages processed by an MMP

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increases, the BLC decreases. (As the messages increase in number, more work is required during a BLC to process the messages. This results in more time being required to complete the BLC). The MMP has a message capacity of more than 1,200,000 messages per hour. The exact number of BLCs at this rate cannot be determined. However, a threshold [for Engineering and Administrative Data Acquisition System (EADAS) or some other type of traffic surveillance system] of 1,200,000 MMP BLCs per half-hour should provide enough time to perform a more thorough analysis of the MMP usage prior to reaching the capacity of the MMP.

As shown in Figure 9.1-1 , the threshold for an MMP can be estimated by graphing the number of messages per half-hour against the number of BLCs per half-hour (from section 18 of the TRFC30 report). A straight line can be projected through the y axis to approximate the number of BLCs per half-hour at the 0-message point. The threshold could be set at 900,000. Figure 9.1-1 is an example, and data for any particular MMP could cause the graph and associated scales to vary.

NOTE: ENGINEERING CONSIDERATIONS for CM2C equipped offices is the same as that for CM1 and CM2 offices.

9.1.4 ASSIGNMENT GUIDELINES

The CM2 offices prior to software release 5E6 and CM2C offices [5E9(1) and later] are equipped with single MMPs. After any retrofit to software release 5E6 or later, these offices should be monitored for SMs with high message traffic. Such SMs may need to grow dual MMPs in offices since SMs equipped with the MC68020 processor have the potential to overload the control time slots (CTS) under ``normal'' call processing. For example, NCT links on SMs having a high penetration and usage of the shared DN features can experience large momentary CTS message traffic leading to excessive occupancies and subsequent message delays. In this feature, the size of the shared DN group contributes to the number of messages per call and, therefore, also to the CTS occupancy.

The dual MMP configuration in CM2 works the same as CM1. The J-Drawing J5D020 A-1 for bays and J5D020 B-1 for growth bays include lists and notes for dual MMP installation. Dual MMPs are optional in the CM2 beginning with software release 5E6 and may be grown after retrofit.

NOTE: ASSIGNMENT GUIDELINES for CM2C equipped offices is the same as that for CM1 and CM2 offices.

9.1.4.1 Existing Offices

In the case of growth of existing offices, if ISDN SMs are to be added, they should be added to dual MMPs. Existing offices should be constantly monitored for SMs with high message traffic using the CTS occupancy counts on Section 125 of TRFC30 as described previously to determine whether or not an SM needs to be on dual MMPs. The reassigning of live SMs from one MMP to another on an in-service basis is not supported.

The procedure performed in a working CM2 office needing to grow and degrow dual MMPs is described in the *Hardware Change Procedure Growth* 235-105-231 and *Hardware Change Procedure Degrowth* 235-105-331.

9.1.4.2 New Start Offices

For new starts, it is recommended that all ISDN SMs should be on dual MMPs. It is advantageous to put ISDN SMs on the same MMP because of the intra-MMP messaging capability, and because ISDN SMs involve high message traffic. If there are multiple MMPs with ISDN SMs, it is advantageous to put those MMPs on the same community of MMPs to share the same dual MMP community since it is recommended that ISDN SMs go on dual MMPs. Two alternatives for the physical arrangement exist for SM assignment and SM numbering. First, the ISDN SMs can be assigned at the beginning of the configuration, and analog SMs can follow the ISDN SMs. Second, the analog SMs can be assigned at the beginning of the configuration and ISDN SMs can be assigned at the end of the configuration. Of course, an office can go

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to 100 percent dual MMPs without any restrictions.

9.1.5 FEATURE IMPACT

The use of some features requires additional messages to be processed by the MMPs. However, the MMPs have a great deal of reserve capacity so that the extra messages generated by features should never cause an overload situation.

Figure 9.1-1 MMP Threshold Determination Example

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9.2 MESSAGE SWITCH CONTROL UNIT

9.2.1 DESCRIPTION

The message switch control unit (MSCU) is responsible for handling interprocessor communication. The MSCU includes the duplex dual serial bus selector (DDSBS); the bus interface controller (BIC); the peripheral interface controller (PIC); and either one or two input-output microprocessor interface (IOMI) circuits, depending on office size.

The DDSBS provides access to the AM. The DDSBS receives serial messages from the AM central control through the dual serial channel (DSCH), performs a serial-to-parallel conversion for transmission to the BIC, and transmits the serial reply message back to the AM.

The BIC acts as a buffer between the 32-bit DDSBS and the 16-bit PIC. The BIC buffers data and command information flowing to the PIC, data and status information from the PIC, and performs the necessary handshaking interface tasks.

The PIC is the main processing element of the MSCU. It services each of the peripheral controllers (PCs) and the AM to facilitate the movement of commands and data between the AM, the PCs [module message processors (MMPs), foundation peripheral controllers (FPCs), and pump peripheral controllers (PPCs)], and the CMP.

The IOMI provides the interface between the 16-bit PIC and one or more 8-bit PCs (a maximum of 16 PCs per IOMI). A PC is an MMP, an FPC, a PPC, or a CMP.

9.2.2 ENGINEERING CONSIDERATIONS

9.2.2.1 Feature Impact

The use of some features requires that additional messages be processed by the MSCU.

9.2.2.2 Capacity Calculation Procedure Based on the TRFC30 Report

During the measurement periods both the MSC0 and MSC1 are assumed to be available. The MSCU capacity is determined assuming just one MSC is available. The capacity is expressed in units of messages per hour (C_{msgs}) and calls per hour (C_{calls}).

- Step 1: For each MSC, plot the BLL cycles per half-hour (TRFC30 report, Section 19) against *S*, the number of messages processed by the MSC per half-hour at low message rates (typically below 20 percent of the expected MSCU capacity) as shown in Figure 9.2-1 . *S* is obtained by the following equation:

  X represents the number of MMPs. The quantities CMPBPIN and CMPBPOT are obtained from Section 126, *CPMSG* is obtained from Section 19, *DLNINPUT* and *DLNOUTPUT* are obtained from Section 66, and $MMPMSG_i$ for each of the MMPs is obtained from Section 18 of the TRFC30 report.

  The quantity Y in equation (A) accounts for the messages sent to the FPC. They are not included in any traffic report. The value of Y is approximated by adding ORIG and INC from TRFC30 Section 5. Y is to be included in S for the MSC with the less active CMP only. As an alternative to using TRFC30 Section 5, the ORIGPC and INCPC from the two TRFC15 reports immediately preceding the TRFC30 report may be used. Refer to Section 2.3.1.9 , High Water mark (PO Percentage) in Traffic Report of 5ESS DLN feature (99-5E-7693), for feature impact information on TRFC30 Section 66.

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Draw a regression straight line (excluding the obvious outliers) through the measurement points, as shown in Figure 9.2-1 , and get M, the intercept of the straight line with the message rate axis. M represents the number of messages processed in a half-hour if the MSC is always busy with message processing.

- Step 2 : For each MSC get T_1, the average time (in *ms*) to process a message according to the following equation:

  [redacted]

  T_1 includes a 0.19 *ms* overhead for each message originated at the MMP or CMP.

  For each MSC determine T_2, the average time (in *ms*) to process a message without the 0.19 *ms* overhead using the following equation:

  [redacted]

  p represents the probability that an arbitrary message originates at an MMP and is given by the following equation :

  [redacted]

  The quantities *Sf1, CPMSG* and *DLNOUTPUT*, needed for calculating *p*, may be obtained at any of the measurement points shown in Figure 9.2-1 . Calculate *p* at a few of those measurement points, take an average, and then use that average in equation (C).

- Step 3 : Take an average,

  [redacted]of the

  [redacted]at the two MSCs as follows :

  [redacted]

- Step 4 : The MSCU capacity in messages per hour, (C_{msgs}), is obtained as follows :

  [redacted]

  The factor 0.84 in equation (F) is used because up to an occupancy of 84 percent of the customer perceived message delay through the PIC for all message types meets objectives.

- Step 5 : As shown in Figure 9.2-2 , plot the total number of messages per half-hour (obtained by adding the quantity *S*, given by equation (A), for the two MSCs) against the total number of calls per half-hour (obtained by adding the peg counts for the ORIGINAT and INCOMING call types from Section 5 of the 30-minute traffic report). Draw a regression straight line (excluding the obvious outliers) through the measurement points. As shown in Figure 9.2-2 , determine, m_0, the intercept of the straight line on the message axis, and, *SLOPE*, the slope of the straight line.

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- Step 6 : The MSCU capacity in calls per hour, (C_{calls}), is obtained as follows :

[redacted]

Equations (F) and (G) above determine the MSCU capacity (when only one MSC is available) in messages per hour and calls per hour, respectively.

9.2.2.3 Comments on Call/Feature Mix

The MSCU capacity depends on the call/feature mix. The measurement points should be taken on an office configuration that has approximately the same call/feature mix as in the larger office for which the MSCU capacity is being determined.

9.2.2.4 Example Capacity and Load-Service Curves

Capacity and load service curves are provided for certain office types based on measurements, expected call/feature mixes for those office types, and a performance analysis model that characterizes the message processing performance of the MSCU. At capacity, 5 percent of processing overhead results from noncall processing messages and 5 percent of overhead is caused by DSCH contention. These are conservative assumptions.

9.2.2.4.1 Example 1: Metropolitan Office

Based on lab measurements,

[redacted] = 0.4867 *ms* per message, *SLOPE = 12.6* messages per call, and m_o = 311 K messages per hour.

Using equations (F) and (G), the MSCU capacity is given as :

- C_{msgs} = 6.214 million messages per hour
- C_{calls} = 468 K calls per hour

Figure 9.2-3 plots the mean and the 95th percentiles of the queuing delay for messages going from the AM/direct link node (DLN) queues to the MMP. Among all the message types these messages experience the maximum queuing delay. It is observed that the capacity is around the knee of the load-service curves.

9.2.2.4.2 Example 2: Toll/Tandem Office

With a mix of 50 percent CCS calls and 50 percent 2-way trunk calls:

[redacted] = 0.5586 *ms* per message, *SLOPE* = 17.97 messages per call, and m_o = 271 K messages per hour.

Using equations (F) and (G), the MSCU capacity is given as :

- C_{msgs} = 5.414 million messages per hour
- C_{calls} = 286 K calls per hour

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Figure 9.2-4 plots the mean and the 95th percentiles of the queuing delay for messages going from the AM/DLN queues to the maximum delay messages (MMP). The capacity for this example is also around the knee of the load-service curves.

Figure 9.2-5 plots the capacity of the toll/tandem office (in calls per hour) as a function of the percent of CCS calls and 2-way trunk calls.

Figure 9.2-1 MSCU Capacity Calculation Step 1

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Figure 9.2-2 MSCU Capacity Calculation Step 5

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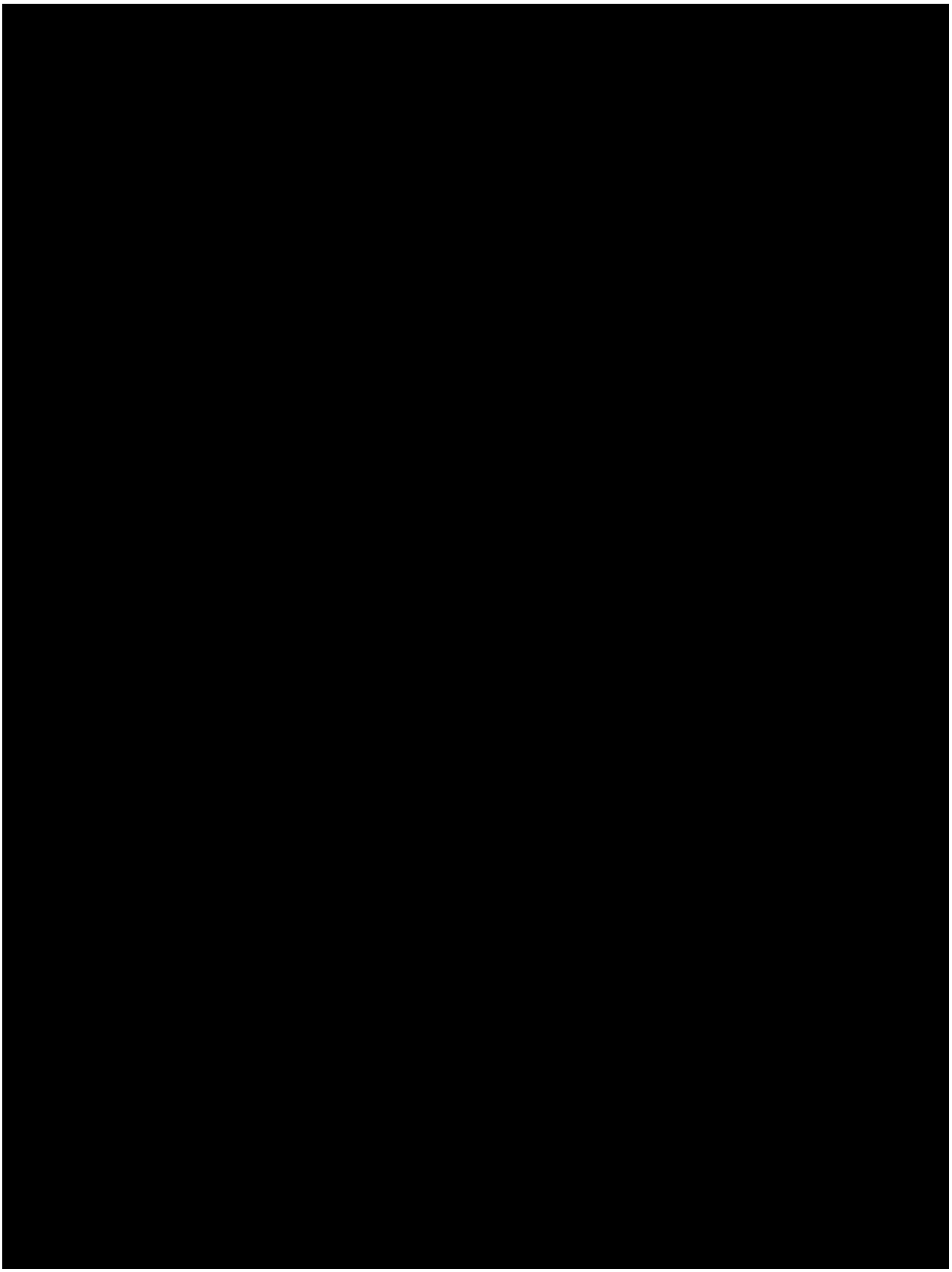

Figure 9.2-3 MSCU Load Service Curves for Metropolitan Offices

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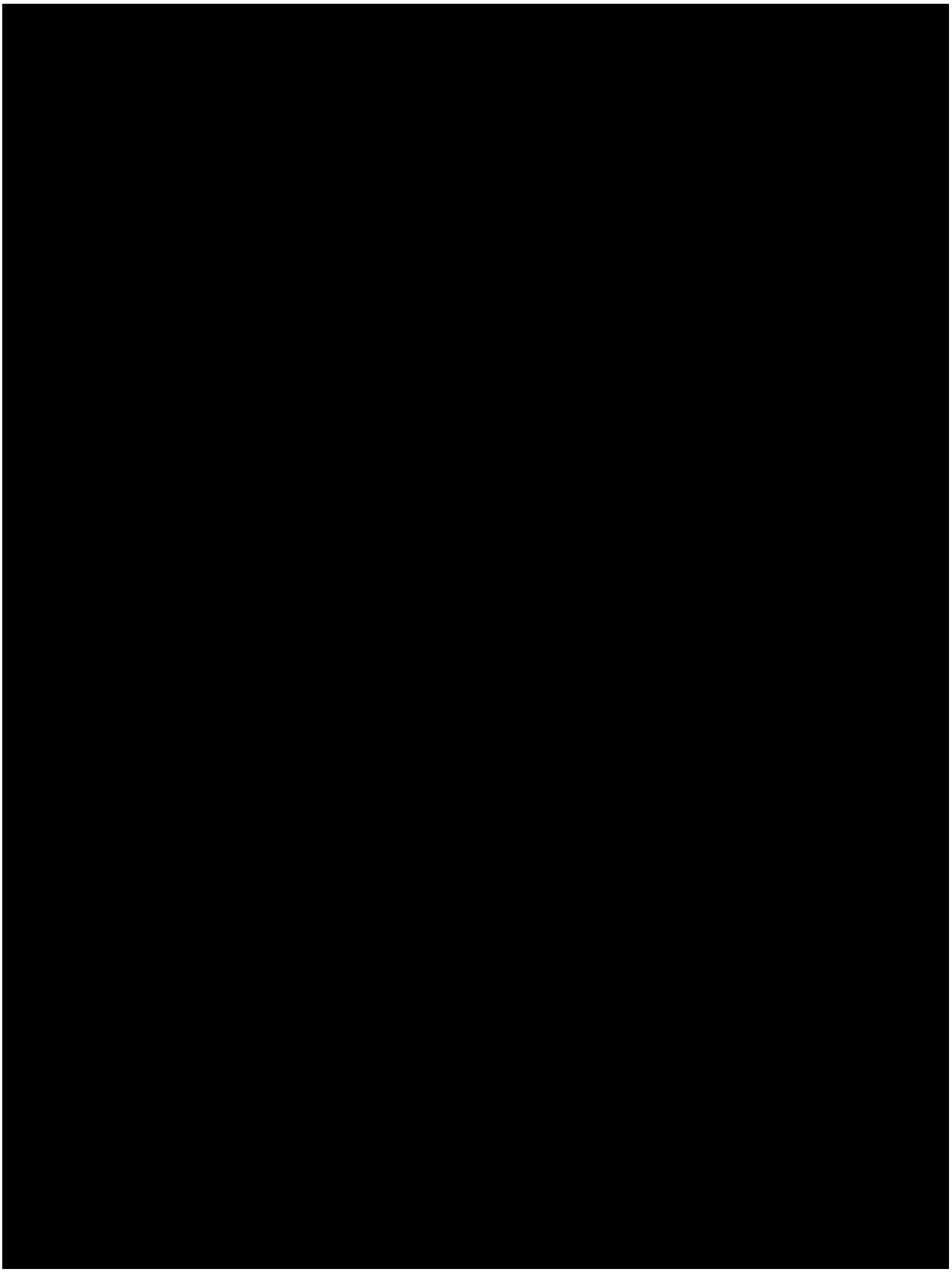

Figure 9.2-4 MSCU Load Service Curves for Toll/Tandem Offices

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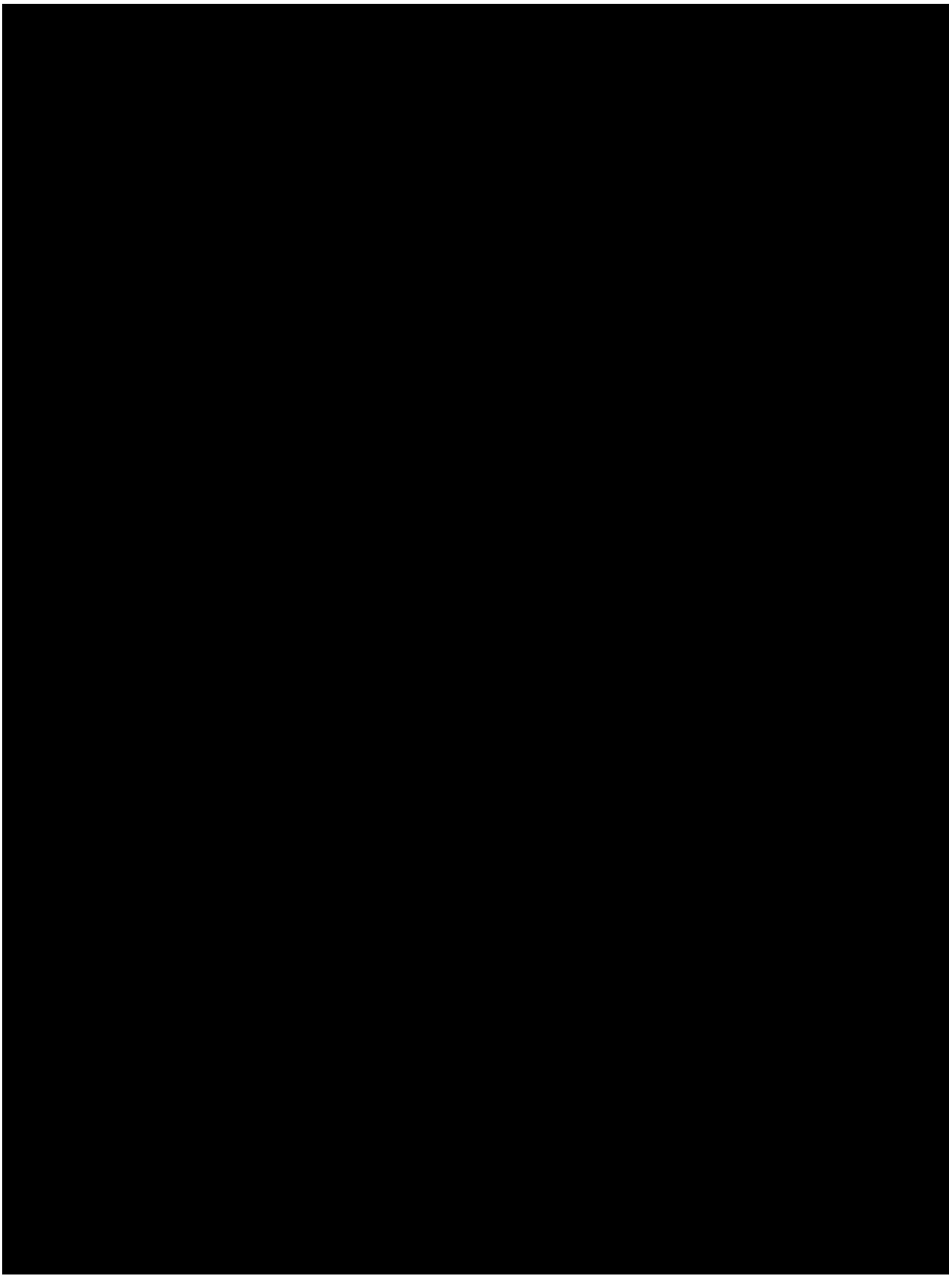

Figure 9.2-5 MSCU Capacity Example

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9.3 MSGS COMMUNICATION MODULE PROCESSOR (CMP)

9.3.1 DESCRIPTION

The CMP was introduced to increase the call processing and operation, administration and maintenance (OA&M) capacity of the *5ESS*® switch. The CMP also provides real-time relief for the AM. The two-board design consists of a 4-MB core board and a 16-MB memory board, equipped with input/output microprocessor interface (IOMI) interfaces to MSCU/PIC and TMS.

The optional CMP Upgrade feature introduces a CMP core board (TN1800). It increases core board memory from 4-MB (with the TN1368) to 16-MB (with the TN1800). The 16-MB auxiliary board is unchanged.

The optional CMP Upgrade may be ordered to upgrade the TN1368 to TN1800 and add the additional memory. The Upgrade consists of plug compatible replacements for TN1368s.

9.3.2 CAPACITY CONSIDERATIONS

With CM3, the CMP capacity is substantially increased over CM2..

9.3.3 ENGINEERING CONSIDERATIONS

For switches configured with the CM1, the CMP plugs into spare MMP slots. For switches configured with the CM2, one shelf is needed on each side of the CM. However, for CM2C offices, only one shelf is needed for both CMPs.

The CMP with call processing application has the following functionalities, among others, in the CMP:

- Packet routing
- Trunk routing
- Trunk translation
- Global service allocation
- Automatic route selection
- Conference Circuit allocation.

9.3.4 ASSIGNMENT GUIDELINES

There are no assignment considerations required for this feature.

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9.4 QUAD-LINK PACKET SWITCH NETWORK

9.4.1 DESCRIPTION

The Quad-Link Packet Switch (QLPS) Network is an overlay network providing high bandwidth/low latency message transport between an SM-2000 and other SM-2000s and between an SM-2000 and the following processors:

- SM
- AM
- FPC
- Direct Link Node (DLN)
- CMP.

For this explanation, the QLPS may be considered to connect "endpoints."

The two QLPS Networks are composed of the following major hardware elements:

- **QLPS** - fits into the same slot as the quad-link interface board in a CM2 single/dual fabric TMS and has access to four TMS fabric ports. The QLPS, QLI1 and QLI2 can be equipped in the same TMSU. The QLPS provides the switching function for high level data link control (HDLC) data frames. It is based upon a number of closely coupled state machines rather than a central processor. The QLPS assembles frames received from the network endpoints, verifies frame integrity, determines the destination, and stores the frames until they are delivered to their destinations. The QLPS provides four 256 time slot links to the TMS fabric and four 32 time slot links out of 1024 time slots are used for QGPs. Time slots are switched based upon the destination field of the HDLC frame. Frames are received on multiple time slot channels. The QLPS supports 127 channels. Each QLPS TN1682 board will occupy one QLI slot in the TMSU. Offices needing a QLPS network will have two QLPS boards per side. QLPS can be used in either single or dual fabric TMSs.

- **QLPS Gate Way Processor (QGP)** - provides QLPS access to and from the MSCU/PIC. Configured in a dual MC68030 processor architecture, the MSGS processor performs I/O functions with the MSCU while the other processor, the AP, accesses the packet bus media access controller (PBMAC). Both QLPS networks may contain 0, 1, or 2 QGPs per MSGS side. Depending on the QGP configuration there may be 0, 4, or 2 QGLs per QGP. If there are 4 QLPSs and 4 QGPs, then each QGP has 2 equipped QGLs. That is, one to each QLPS in the network. Each QGP on a MSGS side serves 1 QLPS network. For example:

  QGP 0-0, 1-0 and QLPS 0-0, 1-0 serve network 0
  QGP 0-1, 1-1 and QLPS 0-1, 1-1 serve network 1.

  If there are 4 QLPSs and 2 QGPs, then each QGP has 4 equipped QGLs. That is, one to each QLPS in both networks. Each QGP on a MSGS side serves both QLPS networks. For example:

  QGP 0-0/1-0 and QLPS 0-0, 1-0 serve network 0
  QGP 0-0/1-0 and QLPS 0-1, 1-1 serve network 1.

  The PBMACs terminate the QGL links between the QLPS and QGPs and provide the necessary HDLC functions required by the QLPS Network. Each MC68030 processor has exclusive use of one MB of static RAM and both processors share another one MB. The QGP's function is to transmit and receive SM-2000 messages over the QGLs, administer and translate appropriate protocol functions, and transmit and receive messages for the AM, the CMP, and SMs by way of the IOMI interface to the MSCU.

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QGP consists of two circuit packs: the gateway processor (QGP), TN1683, and the gateway link (GWL), TN1684. An office may be equipped with zero, two, or four QGPs based on call capacity needs. The QGP resides in the left half of the CMP Unit.

- **Message Handler (MH)** provides access from the SM-2000 processor to the QLPS Network. The MH uses a synchronous/asynchronous protocol data formatter (SPYDER-T} device interface with the QLPS data stream. Based upon MC68040 processor, the MH is allotted 32 time slots by the TSIU-4. These 32 time slots are transmitted and received in the MH by a SPYDER-T device. A subset of these 32 time slots is used to connect into the QLPS Network. The SPYDER-T provides all necessary HDLC functions required by the QLPS Network. One MB of static RAM resides on the MH for the sole use of the MC68040 processor. Another 1 MB resides on the MH and is shared by the SPYDER-T, the MC68040, and the SMP. The MH's function is to transmit and receive messages, performing all level 2 protocol functions, over the QLPS Network for the SMP.

- **QLPS Protocol Handler (QPH)** - provides access between the PSU and QLPS Network.

- **QLPS-QGP Link (QGL)** - interconnection between the QLPS and QGP. Each QGL has a 2 Mb/s bidirectional bandwidth. Each QGP has four QGL connections, one to each QLPS in the OSDS messaging network.

9.4.2 CAPACITY CONSIDERATIONS

WARNING: QLPS functionality requires message handler (MH) pipes between the QLPS and SM-2000. Without MH QPIPEs, the SM-2000 may go into CTS overload and may initialize because of the overload.

If SM-2000 is functional in the office prior to the start of QLPS growth, Message Handler pipes must be grown after completion of QLPS growth in order to make the QLPS functional for the SM-2000.

If SM-2000 is to be grown in the office after the QLPS is functional, the message handler pipes must be grown as apart of the SM-2000 growth procedure. Growth of MH pipes is described in 235-105-210 *Operations and Routine Maintenance*

The *5ESS*® switch operating with software release 5E12 supports both SMs and SM-2000s. Both types support analog lines, digital trunks, ISDN lines, *SLC*® lines, analog trunks and service circuits. Both also act as host SMs to support RSMs. The SMs also support analog lines. The stressed Metro office model (Table 9.4-1) assumes 20 percent of the lines are ISDN.

Table 9.4-1 Required Call Capacities

Office Model		Calls/hr	Average Number Of Messages Per Call						
			SM to SM	SM to CMP	SM to FPC	SM to AM	CMP to SM	SM to DLN	DLN to SM
Local (POTS)		1.5M	4.7	1.7	1.0	0.1	1.0	0	0
Metro	CM2	850K	10.5	2.5	1.1	0.1	1.9	5.0	5.0
	CM3	1.5M							
Toll/ Tandem	CM2	900K	4.5	4.2	1.0	0.3	1.0	6.6	6.6
	CM3	1.5M							

Table 9.4-2 assumes all analog lines and digital trunks are on the SM-2000 even though these can also terminate on SMs. During busy hours, OA&M activities normally add another 10 percent of the messages and are included in Table 9.4-2 .

Table 9.4-2 Required Message Capacities

Office Model	Required Message Capacity

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	(Messages/Hour)	
	QGP COMPLEX	QLPS COMPLEX
POTS	6.3 M	14.9 M
Metro	10.0 M	20.0 M
Toll/Tandem	12.1 M	15.8 M
Signaling messages between the SM and DLN are bundled together up to three or more messages at a time so the actual messages processed by the QGP and QLPS are less than the total number of call processing messages		

A *5ESS*® office with a mix of SM-2000s and SMs may also put a stressed load on the QGP because the QGP then needs to handle messages for calls between SM-2000s and SMs. However, each of the office models, even under worst case assumptions, is less than the maximum of 8.3 million messages/hour.

Under single fault configuration, the QGP complex (2QGP per side, 4QGP configuration) has a throughput of 12.2 million messages/hour (3400 messages/sec) at a processor occupancy of 75 percent or less. Under single fault configuration, QGP complex (1QGP per side, 2QGP configuration) has a throughput of 6.1 million messages/hour (1,700 messages/sec) at a processor occupancy of 75 percent or less. The QLPS complex (always 4 QLPS boards running active/standby) is based on a state machine, and has a throughput many times the largest possible offered load.The offered throughputs are specified with respect to an average message length of 100 bytes, including the message header.

Under single fault configuration, the message links between the QLPS complex and QGP complex have sufficient bandwidth to transmit or receive 10 million messages/hour (2,780 messages/sec) while maintaining an average link occupancy of 60 percent or less. The bandwidth is specified with respect to an average message length of 100 bytes, including the message header. The message distribution is dependent on the call mix and feature usage, and will generally be different for each *5ESS*® office

Table 9.4-3 shows the SM-2000 rated call capacity at 90% SMP occupancy the Toll/Tandem offices models. These offices will be more message intensive than either the POTS or metro offices.

Table 9.4-3 SM-2000 Required Call Capacity

Office Model		Rated Call Capacity (Calls/hr)	
		CORE40	CORE60 (UN588/UN594)
Toll/ Tandem	0.75 TCAP/call	85,000	145,000
	No TCAP	95,000	155,000
	Large Ckt. Tandem	□	120,000

These figures reflect the average number of messages per call shown in Table 9.4-1 , adding 10 percent for OA&M activities and another 30 percent for capacity contingency, the number of messages than an SM-2000 needs to process is given in Table 9.4-4 . These messages go through the message link between the SM-2000 and QLPS.

Table 9.4-4 SM-2000 Required MH Message Capacity

Office Model	Required Message Capacity (Message/Hour)
Tandem	2.85 M
Toll	3.66 M

9.4.3 ENGINEERING CONSIDERATIONS

Current engineering rules specify that the QLPS and a minimum of one pair of QGPs (one per MSGS Side) is required whenever more than one SM-2000 is present. The QLPS also needs to be equipped prior to CM2 to CM3 conversions. For a Office with only one SM-2000 the QLPS is optional, however the message load on the CTSs will need to be monitored to ensure that the occupancy capacities specified in Table 9.1-1 are not exceeded.

TRFC 30 Section 125 shows CTS occupancies for SMs selected by an "ALW" input message at the MCC. This section reports the average occupancy and the maximum occupancy in a 6 second period for each CTS, both transmit and receive, over the previous 30 minute reporting period.

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9.4.3.1 QGP Capacity*(CM2 Only)*

For most switch applications and configurations a QLPS with a single QGP pair is sufficient to handle the interprocessor message traffic. Some switch applications, however, may require two pairs of QGPs to handle the larger message load in some situations. The capacity of a QGP is stated in messages per hour so the number of interprocessor messages per call (handled by the QGP) must be known. The number of messages per call handled by the QGP is the parameter that determines the QGP call capacity for a given switch. A QGP can process about 1,700 messages per second or about 6.1 million messages an hour. Use Table 9.4-5 to determine when two pairs of QGPs should be equipped but keep in mind that this table is for offices with lines and trunks predominantly on SM-2000s (for large, new ship offices only). Offices with SMs growing SM-2000s are not expected to have call distribution spread between SMs and SM-2000s leading to QGP capacity exhaustion. Switches with offered loads greater than these shown should grow the second pair of QGPs.

Table 9.4-5 Single QGP Pair Call Capacity

OFFICE TYPE	CAPACITY PER HOUR
Stressed Metro	480,000
Typical Metro	510,000
Suburban	530,000
Toll/Tandem	500,000

9.4.3.2 Link Engineering for SM-2000

The NCT2 link engineering is available for SM-2000s For the SM an equal number of time slots is available on the peripheral and network sides. For the SM-2000 engineering, the peripheral-to-peripheral feature permits intra-SM calls without NCT2 involvement.

Two types of optical link interfaces are required: Network Control and Timing and Peripheral Control and Timing.

9.4.3.2.1 Network Control and Timing Link

The Network Control and Timing Link between the SM-2000 and its associated CM is referred to as an NTC2 link. The NLI transmits and receives 512 time slots on an NCT2 link, mapping these slots into 768 time slots of the TSI link. This means that 256 time slots are inaccessible on the TSI.

The format on the NCT2 links is equivalent to two interleaved 32 MB NCT links of the SM. This relates to 512 time slots of 16 bits each. NCT2 links are always provided in even and odd pairs. A link carries only odd or only even time slots regardless of the CM2 single or dual fabric configuration.

The following are NCT2 restrictions:

- The NCT2 links of 512 time slots each must be provided in pairs, that is one odd and one even, and must be nested at the same TSI slice (TSIS).
- The NCT2 links must terminate to couplet positions (0 and 1 or 2 and 3). This is expected by peripheral control.
- Two or 4 links may be NCT2 in any slice numbered 1 or higher.
- Only two NCT2 links are permitted on TSIS(0) as described.
- The SM-2000 is limited to 28 cross coupled Line or Trunk Peripheral (LTP) cabinets and 1 SM cabinet (SMC).

9.4.4 OVERLOAD CONTROL

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9.4.4.1 QLPS Overload Control

The QLPS overload control is triggered by critical QLPS failures. They are applied if all QLPS connectivity is lost to an SM-2000. This can occur when all QLNKs are lost when the CM2 is equipped with QGPs (SM-2000) or if all ISMQLNKs are lost when not equipped with QGPs. When this occurs all messages queued for QLNKs or ISMQLNKs are discarded and all new messages are directed to CLNKs. and transmitted or received via the Control Time Slots. Severe throttles are initially applied, but they are gradually relaxed, allowing CLNK occupancy monitors to control the overload condition. Overload controls are immediately retired when QLNKs are again available.

9.4.4.2 QGP Overload Control

The QGP overload control is triggered by resource exhaustion. These overload controls are provided to allow for misengineered offices or multiple fault events. Overload throttles are applied to all SM-2000, throttling originations, terminations, routing requests, or CNI. The degree of throttling depends upon QGP processor occupancies and QGPQPIPE occupancies.

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9.5 COMMUNICATIONS MODULE 2 AND COMMUNICATIONS MODULE 3 WITH SM-2000

9.5.1 CM2 ENGINEERING CONSIDERATIONS

At present the quantity of equipment for a Communication Module (CM) is determined by the number of Switching Modules (SMs) in time slots per SM-2000 and is a variable quantity rather than fixed for CM engineering.

The Network Link Interface (NLI) is the interface between the SM-2000 and the CM2. It transfers time slots back and forth from the Time Slot Interchanger (TSI) links on one side and the Network Control and Timing 2 (NCT2) links on the other side. The NCT2 links are always equipped in pairs. A new set of engineering and ordering rules exist for CM2 offices with SMs (using NCT links), SM-2000s (using NCT2 links), and EXM-2000s (using NCT links).

A CM1 (Communication Module Model 1) office must be converted to a CM2 (Communication Module Model 2) office before installing SM-2000s. It is strongly recommended that existing CM2 single fabric offices with 60 or more SMs convert to CM2 dual fabric before installing SM-2000s in the office, since the current conversion procedure is simple.

The major engineerable items in the CM2 for SM-2000 and SMs follow.

For SMs, the Foundation Link Interface (FLI), TN883, is designed to provide a control interface to the Dual Message Interface portion of the CM Control Unit (CMCU), and it also terminates the NCT links for the first SM on the Time Multiplex Switch (TMS). The NCT2 links used for SM-2000 do not terminate on a FLI pack. The FLI is only provided on base cabinets 5 and 6 (one pack per shelf) of the Time Multiplexed Switch Unit Model 2 (TMSU2) or TMSU3.

The Quad Link Interface (QLI), TN888, is designed to provide the link interface between the CM2 and the SMs. CM2s equipped with QLIs support both single and dual fabric and are equipped on the TMSU2 or TMSU3. Each QLI terminates four NCT links, the equivalent of two SMs.

The CM2 Optical Transceiver (COT), BKF1, terminates the NCT2 links from an SM-2000 (via a NLI) and provides the electrical/optical conversion for the QLI2 circuit pack. Each COT supports two NCT2 links (one pair). COT and QLI2 must be equipped in conjunction with each other (for example, if a QLI2 is equipped in EQL 032, a COT is equipped in EQL 032R).

The COT, 982TT, is used as an optical connector to the SMs. Every two NCT links require a 982TT for the SMs.

The Quad Link Interface 2 (QLI2), TN1681, is designed to provide 64 Mbps NCT2 links between the SM-2000 and CM2, while maintaining the existing interface to the TMS fabric. CM2s equipped with QLI2s support both single and dual fabric configurations. QLI2s can be equipped on both a TMSU2 or TMSU3. Each QLI2 terminates two NCT2 links.

The following are the Office Data Administration (ODA) restrictions for offices equipped with SM-2000 for single fabric link assignments:

- Boards 0 and 1 on TMSU shelf 0 and 1 on base cabinets 5 and 6 cannot be used for SM-2000s (FLIs).
- QLI2 or QLI boards must occupy consecutive board positions within a shelf (at least two at a time).
- Either QLI or QLI2s may occupy multiple sets of consecutive boards, but they can not be mixed.

The Input Output Microprocessor Interface (IOMI), UN25B, provides the interface between the Peripheral Interface Control (PIC) and the Peripheral Controller (PC). There is a maximum of four IOMI circuit packs

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(IOMI-A, IOMI-B, IOMI-C, IOMI-D) per Message Switch Control Unit Model 2 (MSCU2) side. Each UN25B pack can access four IOMI buses. The IOMI-A is always provided (for CMP, FPC, PPC). The other packs are added depending on the number of Message Switch Peripheral Unit Model 3 (MSPU3) communities equipped. The IOMI connection to the QGP will be via a reserved IOMI cable at the third circuit pack (IOMI-C). Some offices require IOMI-C to be equipped before IOMI-B.

New start offices in 5E9(1) and later software releases have the option of using the new version of MSCU called MSCU3 in the CM2. The MSCU3 has a new circuit pack, kBN10 containing the function of four other circuit packs and the first IOMI pack (IOMI-A) UN25B on one board. All four IOMI-A terminate on the kBN10. The IOMI connection to the QGP is through a reserved IOMI cable at the IOMI circuit pack (IOMI-C) or second UN25B.

9.5.2 CM3 ENGINEERING CONSIDERATIONS

This section describes the engineering considerations for the communications module 3 (CM3).

9.5.2.1 Shipping and Growth Configurations

Two CM3 shipping configurations are available: minimum and maximum

The minimum configuration consists of the following:

- Two CMU2 Units (Side 0 and Side 1)
- Full equipage of CMU2 circuit packs (2 TMSF packs per side 0 and 2 per side 1
- Supports up to 20 NCT2 link pairs or 40 NCT1 link pairs (one even link and one odd link as a pair)

The engineerable items include the following:

- NCT2 link optical paddleboards (the number of OPB equals the number of NCT2 link pair)
- NCT1 link optical paddleboards, which use MMA1.

The maximum configuration (up to 92 NCT2 link pairs or 184 NCT1 link pairs in a cabinet) consists of the following components:

- Two CMU2 units (side 0 and side 1)
- Six TMSU4 units (3 side 0 and 3 side 1)
- Full equipage of CMU2 circuit packs (2 TMSF packs per side 0 and 2 per side 1)
- Supports up to 20 NCT2 Link pairs, or 40 NCT1 link pairs terminating on the CMU2
- Supports up to 24 NCT2 link pairs, or 48 NCT1 Link pairs terminating on each TMSU4

The engineerable items include the following:

- NCT2 link optical paddleboards (the number of OPB equals the number of NCT2 link pairs)
- NCT1 link optical paddleboards (the number of OPB equals the number of NCT1 link pairs)
- the number of SM-2000 and EXM-2000s (with TRCU3s) link pairs available equals (184 * 512) - (total NCT1 link pairs * 512)/1024

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- If (total number of NCT1 link pairs) * (512 time slots) + total number of NCT2 link pairs) * (1024 timeslots) is less than or equal to 20,480 then **only** TMSF packs must be populated.
- If (total number of NCT1 link pairs) * (512 time slots) + (total number of NCT2 link pairs) * (1024 timeslots) is greater than 20,480 timeslots but less than or equal to 45,056, then TMSF packs and TMSX packs in the first TMSU4 unit must be populated.
- If (total number of NCT1 link pairs) * (512time slots) + (total number of NCT2 link pairs) * (1024 timeslots) is greater than 45,056 timeslots but less than or equal to 69,632, then TMSF packs and TMSX packs in the first and second TMSU4 unit must be populated.
- If (total number of NCT1 link pairs) * (512time slots) + (total number of NCT2 link pairs) * (1024 timeslots) is greater than 69,632 timeslots but less than or equal to 94,208 timeslots, then TMSF packs and TMSX packs in the first, second, and third TMSU4 unit must be populated.

There are also three CM3 growth kits are available:

- NCT2 link growth kit (when SM-2000s and EXM-2000s require growth)
- TMSX growth kit, includes 4 TMSX boards per TMSU4 shelf
- TMSU4 growth kit (6 TMSU4 shelves for conversion to maximum configuration)

9.5.2.1.1 CM3 NXTMS

In CM3 NXTMS, the additional fabrics are equipped in separate cabinets. The base cabinet contains the first fabric plus the base CM3 circuit packs [Message Switch (MSGS), Network Clock and Control (NCC), and Oscillator (OSC)]. The additional cabinets contain only the additional fabrics. The MSGS, NCC, and OSC circuit packs are not equipped in the NXTMS growth cabinets.

An extended cable is used to provide clock interface between the first cabinet and the additional fabrics in order to maintain synchronization. The growth bays (TMSFP1, TMSFP2, TMSFP3) are strongly recommended to be grown in the same line up as the base cabinet (TMSFP0) and adjacent out to the right hand side. Since each CM3 fabric from the Office Network and Timing Complex (ONTC) perspective is independent of each other, the SM-2000 and EXM□2000 NCT2 links need to be spread across all the desired fabrics; otherwise, there will be a higher probability of inter-SM call blocking if the SM-2000 TMSLNKs are not distributed properly across all the fabrics.

The initial release of NXTMS only supports new start offices with SM-2000s or EXM-2000s with TRCU3s (99-5E-4104) via 5E16.2 software release for wireline applications. The support of SMs in NXTMS is scheduled for 2003 . The first portion below focuses on the rules for CM NXTMS without SMs, and the latter portion focuses on SMs on NXTMS. The software limit for the maximum number of SM-2000s is 23 from which one SM-2000 is used as GSM for SS7 signaling on PSU2. One NCT2 link pair should be sufficient for the GSM.

In order to determine the quantity of NCT2 link pairs per SM-2000 for tandem offices, add the number of trunks per SM-2000 to 128 timeslots (reserved for CTS, QLPS, MH, Pump, etc.) and divide the result by 1024 (timeslots per NCT2 link pair) and round up.

To engineer offices equipped with more than one TMS fabric pair (TMSFP) (the maximum allowed is 4), the quantities of the following items should be determined:

- Total NCT2 link pairs
- Total TMS fabrics (one TMS fabric consists of one TMSF board on a CMU2 shelf and 0 to 3 TMSX boards on TMSU4 shelves).

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- TMS links (TMSLNK) which are the quantity of NCT2 link pairs engineered per each TMSFP(TMSFP0=F1, TMSFP1=F2, TMSFP2=F3, TMSFP3=F4)

Engineering tools are used to perform the calculations. Also refer to the CM3 NXTMS Engineering Guidelines and Engineering Rules.

The table 9.5-1 shows the number of NCT Equivalent ports and the number of available trunk terminations (network timeslots) of the switch when various size CM3 configurations are used. The CM3 meets a 256K trunk objective by utilizing the NxTMS architecture with N>=3.

Table 9.5-1 Base and Growth CM3 Cabinet Capacity

NxTMS Configuration	Equivalent NCT Ports (Even + Odd)	Trunk Terminations
Base CM3 (1xTMS)	184 Even + 184 Odd	94,208
2xTMS	368 Even + 368 Odd	188,416
3xTMS	552 Even + 552 Odd	282,624
4xTMS	736 Even + 736 Odd	376,832

9.5.2.1.2 CM3 NXTMS Engineering Guidelines

There are two engineering guidelines for supporting SM link spread on the fabrics: **even distribution** and **proportionate**. In even distribution, the links are distributed evenly across the fabrics, such as a 3-3-3 distribution.

If even distribution of the links cannot be executed, the proportionate guideline should be followed. The proportionate guideline allows the links to be distributed across the fabrics in direct proportionate with other SM-2000s in the office, such as 4-4-3, or 4-3-3. The basics behind either guideline is the "pool" of time slots being balanced in each fabric pair to ensure communication between the SMs/SM-2000s. Either configurations are considered virtually non-blocking within the TMS fabric in a random trunk group configuration.

9.5.2.1.3 CM3 NXTMS Engineering Rules

(1) The same number of time slots from an SM-2000 should be used to connect to each fabric. These time slots are in modulo 1024 as NCT2 link pairs. This will achieve the optimal capacity and blocking performance. For example, if there are 3 fabrics and 9 NCT2 link pairs, an SM-2000 could have 3 link pairs to each fabric. As another example, if there are 4 fabrics and 8 NCT2 link pairs, one SM-2000 could have 2 link pairs to each fabric .

(2) If RULE 1 cannot be followed, due to office constraints, not enough NLI positions available on the SM-2000 TSI, or economic reasons, then an SM-2000 should connect the same number of NCT2 link pairs to a given fabric in direct proportion to the number of timeslots connected to that fabric by all other SM-2000s. This is a balanced office, even though it may not be an evenly connected office. An example of this configuration would be if all SM-2000s with 11 NCT2 link pairs connected 4 NCT2 links to the first two fabrics and 3 NCT2 link pairs to the third fabric.

9.5.2.1.4 TMSFPs or CM3 Cabinets

The quantity of TMSFPs required for the NXTMS office configuration depends on the total quantity of the NCT2 link pairs. Each TMSFP may handle up to 92 NCT2 link pair (92 even and 92 odd). The minimum number of fabrics are determined by dividing the total number of NCT2 link pairs used in the office by 92 and rounding up (/// below represents divide and round up). as follows

Minimum number of fabrics = total number of NCT2 link pair /// 92

9.5.2.1.5 TMS Fabric Links

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Once the quantity of fabrics are determined, the quantity of the fabric links in office configurations must be calculated, as follows:

- The SM-2000s in an office carrying all the same quantity of NCT2 links (see Example 1) or the SM-2000s in an office carrying different quantity of NCT2 links (see Example 2).
- F1= The number of NCT2 link pairs per SM-2000/// the number of fabrics
- F2 = The number of NCT2 links pair per SM-2000 - F1 /// (the number of fabrics -1)
- If the number of fabrics is >2,, then F3= the number of NCT2 link pair per SM-2000 - (F1+F2) /// (the number of fabrics -2)
- If the number of fabrics is >3, then F4= the number of NCT2 link pair per SM-2000 - (F1+F2+F3) /// (the number of fabrics -3)
- A desired number of fabrics depends on the quantity of the fabric links and the number of SM-2000s. If the quantity of fabric links per each fabric multiplied by the number of SM-2000s is greater than 92, then the minimum number of the fabrics should be increased until the proper distribution of the links has been reached.

9.5.2.1.6 Examples

The following examples illustrate how the above calculations work.

9.5.2.1.6.1 Example 1: An Office with 16 SM-2000s, Each Carrying 11 NCT2 Link Pairs.

The following calculation is used:

- The total number of NCT2 link pair = 16 * 11=176
- Minimum number of fabrics= 176 /// 92 =2
- F1 = 11 /// 2 =6
- F2 = (11- 6) /// (2-1)=5

Based on the above calculation, this office requires 2 fabrics. The first fabric requires 6 link pairs and the second one requires 5 link pairs.

The next step is to test the link pairs to find out whether or not each fabric exceeds the maximum of 92 link pairs. If it exceeds, then the total number of fabrics must be increased, and the links must be spread as equally as possible across each fabric: 16 SM-2000 * 6 link pairs =96, which is not allowed. In this case, the number of fabrics must be increased from 2 to 3:

- F1= 11///3 =4
- F2= (11 -4)/// (3-1)=4
- F3= (11- (4+4)) /// (3 -2) =3

9.5.2.1.6.2 Example 2: An Office with 23 SM-2000s

This example assumes the following SM-200 configurations:

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- 6 SM-2000s, each one carrying 11 NCT2 link pairs
- 6 SM-2000s, each one carrying 10 NCT2 link pairs
- 6 SM-2000s, each one carrying 9 NCT2 link pairs
- 4 SM-2000s, each one carrying 8 NCT2 link pairs
- 1 SM-2000 used as GSM carrying 1 NCT2 link pair

The following calculation is used:

- The total number of NCT2 link pairs = (6*11+6*10+6*9+4*8 + 1)=213
- The minimum number of fabrics= 213 /// 92= 3
- F1 for SM-2000s with 11 pairs = 11 /// 3= 4
- F2 for SM-2000s with 11 pairs = (11-4) /// (3-1)= 4
- F3 for SM-2000s with 11 pairs = (11 - (4+4)) /// (3-2) = 3
- F1 for SM-2000s with 10 pairs= 10 /// 3 =4
- F2 for SM-2000 with 10 pairs = (10-4) /// (3-1) = 3
- F3 for SM-2000 with 10 pairs = (10 - (3+4)) /// (3-2)=3
- F1 for SM-2000s with 9 pairs= 9 /// 3 =3
- F2 for SM-2000 with 9 pairs = (9-3) /// (3-1) =3
- F3 for SM-2000 with 9 pairs = (9 - (3+3)) /// (3-2) =3
- F1 for SM-2000s with 8 NCT2 pairs = 8///3 =3
- F2 for SM-2000 with 8 NCT2 pairs = (8 -3)///(3-1) =3
- F3 for SM-2000 with 8 NCT2 pairs =(8 - (3+3)) /// (3-2) =2
- F1 for SM-2000 (GSM) with 1 pair= 1

In this case, none of the fabrics will exceed the limitation of 92 link pairs, and therefore the minimum number of fabrics, and the desired number of fabrics, remain the same.

In this example, SM-2000s with 11 NCT2 pairs will have the following:

- 4 pairs on TMSFP0 (F1)
- 4 pairs on TMSFP1 (F2)
- 3 pairs on TMSFP2 (F3)

In this example, SM-2000s with 10 NCT2 pairs will have the following:

- 4 pairs on TMSFP0 (F1)
- 3 pairs on TMSFP1 (F2)

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- 3 pairs on TMSFP2 (F3)

In this example, SM-2000s with 9 NCT2 pairs will have the following:

- 3 pairs on TMSFP0 (F1)
- 3 pairs on TMSFP1 (F2)
- 3 pairs on TMSFP2 (F3)

In this example, SM-2000s with 8 NCT2 pairs will have the following:

- 3 pairs on TMSFP0 (F1)
- 3 pairs on TMSFP1 (F2)
- 2 pairs on TMSFP2 (F3)

In this example, SM-2000 with 1 NCT2 pair will reside on TMSFP0.

TMSFP0 must always have the primary NLI links for communication. For SMs on NXTMS up to 90 SMs can be equipped in the first cabinet (TMSFP0) excluding the focus load, 90 will insure the population of SM-2000s get to population of SMs. All the SMs and one GSM will reside in TMSFP0 since primary links have to reside in the first cabinet. The maximum number of cabinets allowed for tandem offices with SMs on NXTMS is 2.

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10. SM RESOURCE UTILIZATION

This section provides information for administering *5ESS*® switch switching module (SM). The assumption is that the reader has a basic knowledge of the *5ESS*® switch architecture and operations. These details are provided in 235-900-1XX - *Product Specification*. The following subsections provide resource utilization information on a physical group basis. Refer to the table of contents at the beginning of each subsection for a complete description of the information included. Each subsection provides information to administer the particular resource.

Worksheets are provided, where applicable, to assist long-term capacity monitoring. These worksheets enable the administrator to determine if the capacity of the SM will exhaust before the end of the engineering period.

The extended switch module-2000 (EXM-2000) is an evolution of the SM providing a significant per time slot cost reduction, enhanced architecture, and platforms for new features and services.

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10.1 SWITCHING MODULE PROCESSOR

10.1.1 DESCRIPTION

The hardware in the switching module (SM/SM-2000) includes line and trunk interfaces, networks, service circuits, and processor control functions. The major parts of the call processing functions are performed in the SM/SM-2000 (such as line and trunk scanning, digit collection, outpulsing, and supervision). Since many calls processed by an SM/SM-2000 involve customers outside that particular SM/SM-2000, many functions and measurements in the SM/SM-2000 are related to half-calls (originating, terminating, outgoing, or incoming calls). The switching module processor (SMP) handles each half-call independently. A terminal process is created in software to perform the necessary tasks associated with the line or trunk for that particular call.

The SMP hardware has undergone continuous development to improve SM/SM-2000 performance. Some of these SMP enhancements provide additional memory addressability, some provide improvements in real-time (faster processor and higher clock rates), and some provide both. The most current information relative to SM and SM-2000 processors in current software releases can be found in Section 10.4 of this document.

The SMP itself is the shelf or unit that functions as central processor unit for the SM, or SM-2000 itself. This is often confused with the designation for the pack within the unit that contains the actual processing components. The available or existent SM MCTU or SM-2000 SMPU shelf types are:

MCTU3 The MCTU3 combines several circuit packs into one reducing the MCTU2 from two shelves to one. The MCTU3 consists of a new Single Board 20 Core pack (SB20CORE), combining two core support packs, the application pack, memory boards and Ethernet interface pack on a single board. The MCTU3 also provides a new power pack, and DLI pack. The SB20CORE circuit pack contains a maximum of three 32 MB memory SIMMs. The MCTU3 is equipped with the TSIU3, PI, DSU2, and CI/CI2 circuit packs. There are two CI slots available permitting a maximum of 46 PICBs. The DI packs support a maximum of 32 PIDBs.

SM-2000 The SM-2000 is the initial processor unit which contained the CORE 40 processor, and is equipped with with four memory slots. This unit is capable of increased processing capacity, and accommodates a larger number of peripheral units than the previous processor types

SM2005 An improved backplane and compressed shelving is shipped with all new offices. The SM2005 design is taken from the SM-2000 and is rearranged and consolidated into a more compressed form. The compressed unit is known as the SM2005 and contains the CORE60 processor. The SM2005 is equipped with two memory board slots, which are equipped with the CORE60MM (UN588)

The SM processor pack of MCTU, MCTU2, or MCTU3 has its own distinct designation and should not be confused with the designation of the processor shelf that contains it. The two designations are not interchangeable. The same is true of the for the SM-2000, SM2005 and their processor boards the CORE40, the CORE60 and CORE60MM. The available processors on the SM/SM-2000 and SM2005 are as follows:

SMP23CDMX The SMP23CDMX is an extension of the SMP23CDM processor. The conversion of a SMP23CDM to a SMP23CDMX involves adding an Update Bus Cable, a new bootstrapper board, the code to support it, and possibly changing the Memory Controller boards. The SMP23CDMX supports 32MB of DRAM on the processor core board and up to 5 4MB (TN2012) on the MCTU shelf. This means that the maximum memory equipage of a SMP23CDMX is 52MB (32MB DRAM + (5 x 4MB)).

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CORE40 The CORE40 was the initial processor equipped in the SM-2000. It has been superseded by later models.

CORE60 The Switching Module Processor 60 (CORE60) replaced the CORE40 in all new SM-2000 switching modules. CORE60 provides an enhanced processor platform with higher capacity that supports processor speed up from 1.5 times over the CORE40. The enhanced CORE60 processor supports the current CORE40 board functionality with the enhancements of the MC68060 microprocessor operating at 50MHz. Also added are a SCRAM Cache subsystem with 512 Kb, optimized CORE I/O, and an additional 64 MB Dynamic RAM.

CORE60MM The CORE60MM is designed to improve the processor performance and provide two CORE RAM memory configurations of either 64MB (UN594) or 128 MB (UN588) CORE40. The 128 MB CORE60MM (UN588) is used for all new shipped SM2005 SMs.

A SMP capacity graph is shown in Figure 10.1-1 . The graph indicates that the SM should reach call carrying capacity at approximately 90 percent occupancy. The amount of overhead varies due to differences in the configuration of the SM [number of line units, concentration ratios used, number of SMs in a multimodule remote switching module (MMRSM), etc.]. Typically, about 55 to 70 percent of the SMP real-time is allocated to call processing functions.

It is very likely that the line units in a SM will reach usage (CCS) capacity before the SMP reaches call capacity. In the event that the SMP reaches or exceeds capacity, service deterioration may occur in the form of dial tone delay.

10.1.2 ENGINEERING CONSIDERATIONS

Decisions must be made on the SMP configuration, the maximum number of peripheral units assigned in the SM because of the real-time call capacity of the SMP, and the type and amount of memory required.

The SMP configuration decision is based on the integration of Integrated Services Digital Network (ISDN) on the SM. If it will house either, the SMP must be an MCTU2 or better. If the SM will not house either, but will require certain ISDN capabilities (such as shared analog DN), the SMP must be at least equipped with an SMPU2 or MCTU with the 68012 processor. If the SM will not contain ISDN hardware and will not require ISDN capabilities, the SMP configuration may be any of the configurations supported by the software release. The decision of which SMP to use in any given SM is based on real-time capacity and availability of SMP types.

- ***OSPS:*** The possible OSPS position switching module (PSM) applications include directory assistance (DA), toll and assistance (T&A), and commercial automatic call distribution (ACD). The OSPSs are provided in terms of operator positions supported as well as busy-hour call capacities.

- ***ISDN:*** In general, an ISDN SM has more real time available for call processing due to the absence of analog line scanning. The capacity of an ISDN SM equipped with an SMP20 in terms of PODS (Plain Old Digital Service), the equivalent of an analog line-to-line call is 7,500 calls per hour, assuming 78 percent of SMP real-time is allocated to call processing. The actual SMP call capacity depends on the mix of the voice and data features; typical ISDN SMs have capacities in the range of 5,000 to 7,500 feature-rich calls per hour. The 5,000 calls per hour value is based on a stressed SM with more than 50 percent of the directory numbers (DNs) being shared and 1 or 2 business and residential custom services (BRCS) features used per call. The 7,500 value corresponds to little shared DN and less than 20 percent of the calls using BRCS features.

As with the AM/CMP, the capacity of the SM has been determined through laboratory measurements and is given for specific call types and features. The same call-mix model given in the section on *AM/CMP Processor Capacity* is assumed to establish the real-time requirement.

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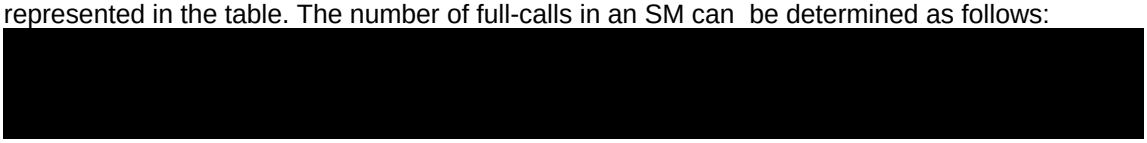
The real-time call capacity of the SMP must be considered when engineering the SM. If five ISLUs are put on an SM and are loaded to capacity with centrex users who use their features often, there may be a real-time call capacity problem. Refer to the Real-Time Call Capacity Worksheets for more information.

Since a call may originate in one SM and terminate in another, it is reasonable to measure the load on the SM in terms of the number of full-calls per hour.

The real-time call capacity of an SMP varies based on the software release and SMP configuration employed. These capacities are shown in Section 10.4 . The capacities are given in EQPOTS (nonfeature) calls per hour at a processor occupancy rate of 90 percent. The TRFC30 report provides call measurements in terms of half-calls, which equal approximately twice the number of full EQPOTS calls represented in the table. The number of full-calls in an SM can be determined as follows:



The number of half-calls handled and the processor occupancy in each 30-minute period in Section 15 of the TRAFFIC 30 reports are measured and transmitted to engineering and administrative data acquisition system (EADAS), the switching control center system (SCCS), the local maintenance channel, and the network administration center (NAC) channel.

10.1.3 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Section 15 for circuit-switched calls and Section 69 for packet-switched calls of the TRFC30 report and Part 2 of the 15-minute traffic report provide measurements related to processors. For the SM, the key measurements are percent occupancy and blockage due to overload.

10.1.3.1 Percent Occupancy

The percent occupancy measurement in the TRFC30 Section 15, field name **Percent OCC**, represents the percentage of time the processor spends processing calls and other nondeferrable work. As the SMP percent occupancy approaches 90 percent, dial tone delays may be noticed. As long as the percent occupancy is less than 70 percent for the SMP, any degrade of service should not be attributed to the processor.

10.1.3.2 Blockage Due to Overload

The calls blocked during a(n) AM/CMP overload (BLKOVD) count in the TRFC30 Section 4 is incremented when it is determined (in the SM) that a route request message cannot be sent to the AM/CMP because it is in an overload condition. In this case, the call is routed to reorder tone. Under normal circumstances, this count should not exceed zero.

10.1.4 FEATURE IMPACT

The SMP performs more than 95 percent of the work required to support features. Therefore, a heavy penetration of features or the implementation of new features can have a significant impact on the SMP. Specifically, BRCS features provide additional loads on the SMP. Other features such as Carrier Interconnect may have additional impact on the SMP. **For details concerning feature descriptions and impacts, refer to the** 235-190-XXX *document series*.

10.1.5 TRANSITION IMPACT

It may be necessary to convert from one of the SMP configurations to another. This conversion may be necessary due to a software release update or retrofit, or the implementation of new features. These conversions may be required to provide access to more memory or to provide additional real-time (a faster processor), or both.

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Unit and subunit growth may have an impact on the SMP. Hardware changes as well as memory changes (recent changes) may be required. These growth procedures are performed on a "live" system and therefore require great care to prevent service interruptions.

Unit growth is the addition of peripheral units. This includes the growth of an entire peripheral unit, as well as the growth of a service group (SG) in an existing unit. Examples include the growth of a trunk unit, local digital service unit, digital line trunk unit (DTLU), line unit (LU), digital carrier line unit (DCLU), global digital service unit (GDSU), or metallic service unit (MSU). Although peripheral unit and SG growth necessitate wiring and cabling, much of this is connectorized. The MSU and directly connected test unit (DCTU) are for testing purposes and do not provide call processing functions.

The growth of a peripheral unit in the *5ESS*® switch differs significantly from the corresponding growth for an analog office. The biggest difference is the use of serial data and control buses for interconnection to the network. Necessary assignments and connections include: the addition of peripheral interface data buses (PIDBs) and peripheral interface control buses (PICBs) to an appropriate data interface (DI) and control interface on the SM; wiring the metallic test buses (MTBs) for metallic access to the unit; cabling and wiring for the backplane connectors; physically mounting the shelves on a frame; assigning time slots if necessary; and the recent change for the common and control circuits. Power sources and fuses must be checked, and the unit's integrity must be verified before it is brought up in the live office. The growth of new peripheral units on an existing SM requires additional office wiring, and is primarily a Lucent Technologies installation activity (unless local practices dictate otherwise).

Subunit growth includes the growth of assignable packs within peripheral units, the translations associated with each pack, diagnostic and operational tests, and the equipage state for each pack. This stage of growth includes the addition of the logical name for the termination (for example, trunk equipment number) and the pack type and vintage. Examples include the growth of trunk circuit packs in a TU, the growth of a carrier system on a DFI in a DLTU, the growth of MSU or GDSU packs, and the growth of an entire integrated *SLC*® 96 carrier remote terminal (RT) or an individual channel unit on the RT which would affect the DCLU. The growth procedures for the DFI do involve PIDB and PICB cabling, but no frame, shelf, or power work is necessary. This level of growth can occur any time during an engineering interval, as dictated by the projection of demands of the switch owner.

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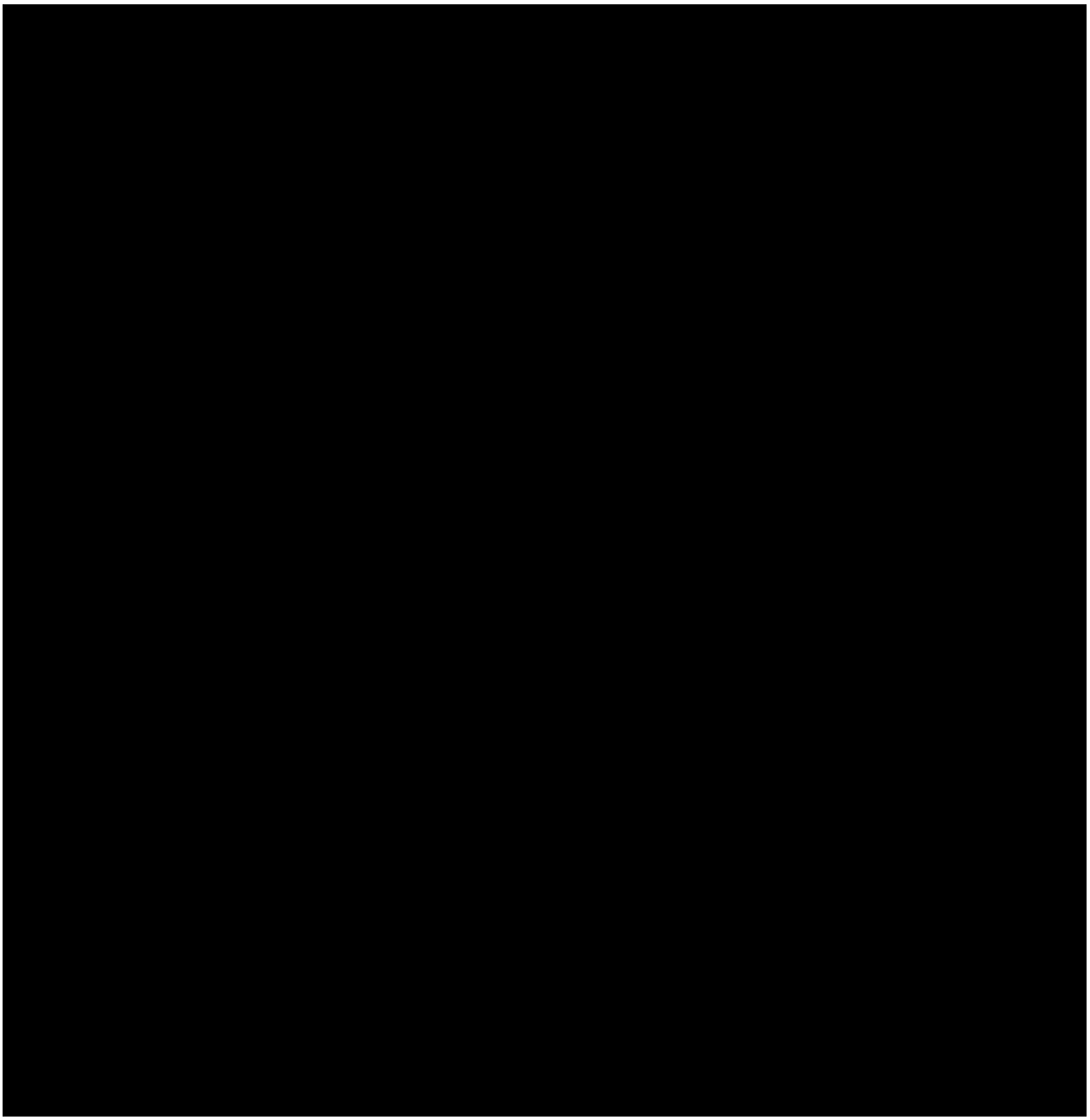

Figure 10.1-1 Switching Module Processor Capacity Example [5E2(2) and Later Software Releases]

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10.2 SWITCHING MODULE REAL-TIME WORKSHEETS

The SM Real-Time Worksheet estimates the switching module (SM) real-time call capacity either in half calls per busy hour or in full calls per busy hour at 90 percent occupancy, and the SM processor (SMP) occupancy at the offered load in the *5ESS*® switch. The worksheet enables switch customer to make an appropriate assignment of lines, trunks, attendants, and features to SMs, considering the associated real-time use of the SMP. The worksheet calculates real time consumption for the SMP12, but it can be applied to SMs equipped with SMP1, SMP20, SMP20 data cache, and SMP23 using the conversion factors inside the worksheet. The term "SM" used in this worksheet refers to an SM, remote switching module (RSM), or optically remote module (ORM). As a general guideline, this worksheet is needed only when one of the following is true:

(1) (Average high day (Originating + Terminating) calls/line) multiplied by
SUM of {

(Number of analog nonshared DN centrex lines),

2 □ (Number of analog shared DN centrex lines),

80 □ (Number of analog attendant consoles),

1.5 □ (Number of BRI/DSLs which have no shared DN),

2 □ (Number of BRI/DSLs which have at least one shared DN),

120 □ (Number of digital attendant consoles)}

1 □ (Number of ACD/BRCS agents)}

plus

(Average high day (Incoming + Outgoing) calls/trunk)
multiplied by 0.7 □ (Number of trunks)is greater
than 8,000.

NOTE: The current Basic Rate Interfaces (BRIs)/Digital Subscriber Lines (DSLs) and packet trunks are only equipped on SMs with the SMP20, SMP20 data cache, and SMP23 processor.

(2) There is an applications processor (AP) attached to the SM and one of the following is true:

a. Number of lines is more than 200
b. Number of attendant consoles is more than 3

10.2.1 SOURCES OF DATA

10.2.1.1 5E10 and Later Software Releases

In the 5E10 and later software releases, there are many different call types. Instead of providing the SM real-time usage for each call type and requesting input such as "number of calls per busy hour" for each

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call type, the following approach simplifies the call capacity estimation process.

Analog lines are classified into different categories or types, such as POTS lines, rural/suburban lines, nonattendant electronic tandem network (ETN) lines, etc. These classification criteria are based on the features assigned to the lines. For example, a rural/suburban analog line is any analog line assigned with at least one of the following features: speed calling, call forwarding, call waiting, 3-way calling. If a line has other features in addition to any of these, then it is classified as a metro analog line. Detailed definitions of each analog line type is found in the worksheet (items 6 through 12). An analog line should be classified into only one type. For each type of analog line, the expected SM real-time usage is provided for an average call made from this type of line. The expected SM real-time cost for an average call made from this type of line is based on an assumption that a certain call mix is generated from this type of analog line. Instead of input such as "number of certain feature calls per busy hour," inputs such as "number of calls made from/to rural/suburban analog lines per busy hour" are requested. This approach simplifies the SM call capacity calculation.

Similarly, ISDN BRI/DSLs are classified into different types based on the features assigned to the BRI/DSL and its DN, that is, featureless BRI/DSL, nonattendant, non-ETN, nonshared DN, digital centrex, etc. Detailed information is found in the worksheet. In the SM Real-Time Worksheet, a multipoint BRI/DSL supporting three users is considered as having three ISDN BRI/DSL users. An ISDN BRI/DSL can simultaneously be used for different features at different times or even at the same time. For example, a BRI/DSL can support both voice and data. Also, since a BRI/DSL may have multiple DNs associated with it, a BRI/DSL voice traffic can be a mix of nonshared DN and shared DN. One BRI/DSL can belong to more than one type.

Trunks are also classified into five types, and each trunk belongs to only one type.

For each type of analog line, the number of calls made from this type of line can be estimated indirectly as follows:

(average high day calling rate per line) □ (number of this type of line)

or

(average CCS per line) □ (average holding time in seconds per call) □ (number of this type of line), if the average high day calling rate per line is not directly available.

The output of this worksheet is the percent of the SMP12 (or SMP with speedup) call capacity used by the offered load and the call capacity at 90 percent occupancy. By using the worksheet, the administrator also accesses the relative real-time call capacity impact of each kind of analog line, BRI/DSL, trunk, AP, and miscellaneous circuits.

10.2.2 USING THE WORKSHEET

The SM real-time worksheet provides spaces to enter the input data and the results of the arithmetic calculations. In many cases, a "skeleton equation" is provided below the basic line in the worksheets for your convenience in making intermediate calculations to determine " ***YOUR INPUT***."

The means for determining the data inputs may vary. As an example, input data for ***CALL WAITING*** can be determined as follows:

- Data can be collected for all terminal groups in the SM.
- Data can be collected on a selected subset of terminal groups and the results extrapolated to represent the office totals.

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Nominal or "common-sense" values may be used to supplant the need for a detailed analysis in many instances, particularly where low feature-penetration exists in the office.

Also, note that the ***MSEC PER CALL*** coefficient is a measure of the relative importance of the various inputs. For example, ***SPEED CALLING, 1 Digit*** is much less significant than ***CALL TRANSFER***.
OVERHEAD OCCUPANCY CALCULATION The minimum overhead occupancy of the SMP12 is 20 percent of the switching module processor (SMP) processor's time. Additional no-load occupancy requirements occur (items 1 through 5 below) is incurred from analog line units in the SM/RSM and depends on the number of line units in the SM/RSM, and the line unit concentration ratio. There is additional overhead occupancy in an MMRSM, depending on the number of RSMs in the MMRSM cluster. No additional overhead is incurred by ISLUs in the SM or RSM.

Please input the expected traffic partition & feature

penetration during a 1 hour interval.

The general format of this worksheet is:

SM TRAFFIC PARTITION (NUMBER OF CALLS/HOUR)		SMP12 OCCUPANCY NUMBER OF UNITS	SMP12 OVERHEAD PER UNIT PERCENT)	OCCUPANCY (PERCENT)
_____	_____	x _____	= _____	

_____

1. NUMBER OF 4:1 LINE UNITS x 0.75 =

ON THIS SM OR RSM._____ _____ _____

2. NUMBER OF 6:1 LINE UNITS. x 0.95 =

ON THIS SM OR RSM._____ _____ _____

3. NUMBER OF 8:1 LINE UNITS x 1.20 =

ON THIS SM OR RSM._____ _____ _____

4. NUMBER OF 10:1 LINE UNITS x 1.45 =

ON THIS SM OR RSM._____ _____ _____

5. IS THIS AN SM IN AN MMRSM x 0.87 =

CLUSTER? _____ _____ _____

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If yes, enter one less than the number of SMs in the cluster,

else enter "0" for example, for a 4-module MMRSM enter "3".

Note: Maximum number of RSMs in an MMRSM cluster is 4.

_____

Sum of the above 5 calculations (items 1 through 5) ==> |A: _____|

Expected no-load occupancy (A + 20) ==> |B: _____|

_____

TRAFFIC PARTITION

(ORIGINATING AND TERMINATING CALL MIX)

Please input traffic partition during your high day busy hour

(number of (O+T) calls per hour). The number of originating and

terminating calls per partition can be estimated as follows:

average high-day busy hour calling rate of O+T calls per end-user number of end-users

or

average high day busy CCS per end user
_____ x number of end-users

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average holding time in seconds per call

Where the "end-user" is defined as:

1. Customer premises equipment (CPE) such as an analog phone, shared or nonshared directory number (DN) of a digital phone, terminal, attendant console, printer, computer, FAX machine, applications processor (AP), etc.

2. Another switch (local, tandem, toll, PBX, etc.)

3. Conference circuit

4. Announcement circuit.

ANALOG LINES

TRAFFIC PARTITION

If your SM has analog traffic, at least some of items 6 through 15 should be used. Each analog line should be classified in only one category.

6. NUMBER OF CALLS WHICH USE x 161 =

POTS LINES _____ _____ _____

(181, if RSM)

Number of calls per hour which originate from or terminate on

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POTS lines in this SM or RSM. No features are assigned to these lines.

7. NUMBER OF CALLS WHICH USE x 193 =

RURAL OR SUBURBAN ANALOG LINES _____ _____ _____ (213, if RSM)

Number of calls per hour which originate from or terminate on rural or suburban analog lines, that is, analog lines with at least one of the following features assigned: speed calling, call forwarding, call waiting, or 3-way calling. If lines have features in addition to any of the ones mentioned here, it should not be included in this classification.

8. NUMBER OF CALLS WHICH USE x 247 =

NONATTENDANT NON-ETN _____ _____ _____

(NONELECTRONIC TANDEM NETWORK)(267, if RSM)

ANALOG CENTREX LINES

Number of calls per hour which originate from or terminate on nonattendant, non-ETN, analog centrex lines, that is, analog lines with at least one of the following features assigned: call pickup, individualized dialing plan (IDP), call transfer, automatic route selection (ARS), private facility access (PFA), terminal groups, modular queuing for lines, intercom call restriction (ICR), carrier interconnect (CI), or multiline hunt group (MLHG). These lines may also have been assigned features as listed in item 7, but they cannot have other types of features assigned. In particular, this item does not include

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shared DN lines included in item 10.

9. NUMBER OF CALLS WHICH USE x 271 =

NONATTENDANT ETN ANALOG _____ _____ _____

CENTREX LINES (291, if RSM)

Number of calls per hour which originate from or terminate on nonattendant ETN analog centrex lines; that is, analog lines with at least one of the following features assigned: ETN trunk queuing, deluxe ARS, authorization and account code, message detailed recording (MDR), or simulated facilities group (SFG) calls. These lines may also have been assigned features as listed in items 7 and 8. This item does not include shared DN lines included in item 11.

10a.NUMBER OF NON-ATTENDANT, NON ETN x 480 =

SHARED DN ANALOG CENTREX _____ _____ _____

(500, if RSM)

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 2 to 4 members.)

10b.NUMBER OF NON-ATTENDANT, NON ETN x 720 =

SHARED DN ANALOG CENTREX _____ _____ ___

(750, if RSM)

Number of calls originated from, or terminated to, a shared DN

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of non-attendant non-ETN analog centrex lines. (From 5 to 8 members.)

10c.NUMBER OF NON-ATTENDANT, NON ETN x 950 =

SHARED DN ANALOG CENTREX_____ _____ _____

(990, if RSM)

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 9 to 32 members.)

11a.NUMBER OF NON-ATTENDANT, ETN x 510 =

SHARED DN ANALOG CENTREX _____ _____ _____

(530, if RSM)

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 2 to 4 members.)

11b.NUMBER OF NON-ATTENDANT, ETN x 750 =

SHARED DN ANALOG CENTREX _____ _____ _____

(780, if RSM)

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 5 to 8 members.)

11c.NUMBER OF NON-ATTENDANT, ETN x 980 =

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SHARED DN ANALOG CENTREX _____ _____ _____

(1020, if RSM)

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 9 to 32 members.)

12. NUMBER OF CALLS WHICH USE x 632 =

ANALOG ATTENDANT _____ _____ _____

(652, if RSM)

Number of attendant or centralized attendant calls per hour. This item is for SMs or RSMs with any analog attendant console.

NON-ISDN TRUNKS

Note: Each trunk should be classified in only one of the categories (items 13 through 18).

13. NUMBER OF CALLS WHICH USE x 146 =

POTS TRUNKS _____ _____ _____

(166, if RSM)

Number of incoming and outgoing calls per hour on POTS trunks that originate from or terminate on this SM or RSM.

14. NUMBER OF CALLS WHICH USE x 210 =

TRUNK CENTREX _____ _____ _____

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(230, if RSM)

Number of incoming and outgoing calls per hour on trunks which have at least one of the following features assigned: Uniform Numbering Plan, Overlap Outpulsing, or Cut-Through calls.

15. NUMBER OF CALLS USE x (240+27xNDS0) =

FRACTIONAL DS1 TRUNKS _____ _____

(260+30xNDS0),if RSM)

Number of incoming and outgoing calls per hour on DS1 trunks on this SM/RSM, multiplied by the average of DS0 channels involved in the fractional DS1 trunk calls.

ISDN TRUNKS AND PRI

16. NUMBER OF CALLS WHICH USE x 45 =

TRUNK PACKET SWITCH DATA _____ _____ _____

Number of calls per hour over the incoming internal protocol (IP) trunk. This item is applicable if this SM or RSM is equipped with incoming IP trunks.

This item is applicable if this SM/RSM is equipped with incoming internal protocol (IP) trunks.

17. NUMBER OF CALLS WHICH USE x 180 =

PRIMARY RATE INTERFACES _____ _____ _____

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PLAIN OLD DIGITAL SERVICE

(PODS(205, if RSM)

Number of voice-only calls per hour originating from or terminating on featureless primary rate interfaces (PRI) which go to PBXs. This item is applicable if this SM or RSM is connected to PBXs by PRIs.

18. NUMBER OF CALLS WHICH USE x 230 =

PRI CENTREX _____ _____ _____

(255, if RSM)

Number of voice-only calls per hour originating from or terminating on PRIs having INWATS or OUTWATS features going to a PBX. This item is applicable if this SM or RSM is connected to PBXs by PRI.

19. NUMBER OF CALLS WHICH USE x (420+27xNDS0) =

FRACTIONAL DS1 PRI _____ _____ _____

((460+30xNDS0), if RSM)

Number of incoming and outgoing calls per hour on DS1 PRIs on this SM/RSM, multiplied by the average number of DS0 channels involved in the fractional DS1 trunk calls.

APPLICATION PROCESSOR

Items 20 through 24 are applicable only if an AP is attached via

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BRI/DSLs to the SM/RSM. The real time for these items as indicated in the "SM REAL-TIME CONTRIBUTION" column is the SMP real time spent in processing messages between the AP and the SMP. The SMP real time spent on processing messages between the user's ISDN CPE and the SMP can be found in items 36 and 37.

20. NUMBER OF CALLS WHICH USE x 25 =

AP MESSAGE DETAILED _____ _____ _____

RECORDING (MDR)

Number of MDRs per hour that are generated by the switch and sent to the SM AP.

21. NUMBER OF CALLS WHICH USE x 50 =

AP MESSAGE SERVICE _____ _____ _____

SYSTEM (MSS) OR

ELECTRONIC DIRECTORY SERVICE (EDS)

Number of times per hour that an MSS or EDS system on the SM AP is initiated by the switch analog user.

22. NUMBER OF CALLS WHICH USE x 120 =

AP MSS OR EDS _____ _____ _____

Number of times per hour that an MSS or an EDS session on the SM AP is initiated by the switch ISDN users. This item is applicable if up to 40 percent of the AP MSS or EDS ISDN users have the 40-character display feature.

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23. NUMBER OF CALLS WHICH USE x 135 =

AP MSS OR EDS _____ _____ _____

Number of times per hour that an MSS or an EDS session on the SM AP is initiated by the switch ISDN users. This item is applicable if 41 to 60 percent of the AP MSS/EDS ISDN users have the 40-character display feature.

24. NUMBER OF CALLS WHICH USE x 160 =

AP MSS OR EDS _____ _____ _____

Number of times per hour that an MSS or an EDS session on the SM AP is initiated by the switch ISDN users. This item is applicable if more than 60 percent of the AP MSS or EDS ISDN users have the 40-character display feature.

INTELLIGENT PROCESSOR

One example of an intelligent processor is a service circuit node linked to the SM via a BRI/DSL.

25. NUMBER OF CALLS WHICH USE x 580 =

INTELLIGENT PROCESSOR _____ _____ _____

INITIATED TRANSFER (610,IF RSM)

Number of calls terminating to a peripheral intelligent processor, with the intelligent processor then causing a call

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transfer to occur. The real times include only the intelligent processor termination and call transfer components and not any consumption by other features which may be involved in the call. The total effect on the SM real time consumption depends on how each vendor implements the feature on the intelligent processor.

CONFERENCE AND ANNOUNCEMENT CIRCUITS

26. NUMBER OF CALLS WHICH USE x 100 =

CONFERENCE CIRCUITS _____ _____ _____

Number of times per hour that conference circuits are used.
This item applicable if conference circuits are on the SM or RSM.

27. NUMBER OF CALLS WHICH USE x 125 =

ANNOUNCEMENT CIRCUITS _____ _____ _____

Number of times per hour that announcement circuits are used.

ISDN LINES

If the SM has ISDN traffic, at least some of items 28 through 42 should be used. One BRI/DSL can belong to more than one category.

28. NUMBER OF CALLS WHICH USE x 240 =

PLAIN OLD DIGITAL_____ _____ _____

SERVICE (PODS) (265, if RSM)

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Number of calls per hour which originate from or terminate on featureless BRI/DSLs on the SM or RSM.

29. NUMBER OF CALLS WHICH USE x 330 =

NONATTENDANT NON-ETN _____ _____ _____
NONSHARED DN DIGITAL CENTREX (355, if RSM)

Number of calls per hour which originate from or terminate on a nonattendant, non-ETN, centrex, nonshared DN of a BRI/DSL. A nonattendant, non-ETN, centrex, nonshared DN is a nonshared DN with at least one of the following features assigned on the DN or BRI/DSL (and no other features assigned) speed calling, call forwarding, 3-way calling, call waiting, call pickup, call transfer, IDP, ARS, PFA, terminal group, modular queuing for lines, ICR, CI, MLHG, LASS, and ASP.

30. NUMBER OF CALLS WHICH USE x 357 =

NONATTENDANT ETN _____ _____ _____

NONSHARED DN DIGITAL CENTREX (382, if RSM)

Number of calls per hour which originate from or terminate on a nonattendant, ETN, centrex, nonshared DN of a BRI/DSL. A nonattendant, ETN, centrex, nonshared DN has at least one of the following features assigned to the DN or the BRI/DSL: queuing for trunks, deluxe ARS, authorization codes, account codes, and SFG. Features listed in item 29 may also be assigned to the DN or the BRI/DSL.

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31a. NUMBER OF NON-ATTENDANT, NON ETN x 480 =

SHARED DN DIGITAL CENTREX _____ _____ _____

(SMALL GROUP) (500, if RSM)

Number of calls originated from, or terminated to, a shared DN of a BRI/DSL or a multipoint BRI/DSL. (From 2 to 4 members.)

31b.NUMBER OF NON-ATTENDANT, NON ETN x 720 =

SHARED DN DIGITAL CENTREX _____ _____ _____

(MEDIUM GROUP) (750, if RSM)

Number of calls originated from, or terminated to, a shared DN of a BRI/DSL or a multipoint BRI/DSL. (From 5 to 8 members.)

31c.NUMBER OF NON-ATTENDANT, NON ETN x 950 =

SHARED DN DIGITAL CENTREX _____ _____ _____

(LARGE GROUP) 990, if RSM)

Number of calls originated from, or terminated to, a shared DN of a BRI/DSL or a multipoint BRI/DSL. (From 9 to 32 members.)

Note: With respect to items 32a, 32b, and 32c, a non-attendant, ETN centrex shared DN is a shared DN with at least one of the features listed in item 30 assigned on the DN or the BRI/DSL or the multipoint BRI/DSL. Features listed in item 29 may also be assigned on the DN or the BRI/DSL.

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32a.NUMBER OF NON-ATTENDANT, ETN x 510 =

SHARED DN DIGITAL CENTREX _____ _____ _____
(SMALL GROUP) (530, if RSM)

Number of calls originated from, or terminated to, a shared DN

of a BRI/DSL or a multipoint BRI/DSL. (From 2 to 4 members.)

32b.NUMBER OF NON-ATTENDANT, ETN x 750 =

SHARED DN DIGITAL CENTREX _____ _____ _____

(MEDIUM GROUP) (780, if RSM)

Number of calls originated from, or terminated to, a shared DN

of a BRI/DSL or a multipoint BRI/DSL. (From 5 to 8 members.)

32c.NUMBER OF NON-ATTENDANT, ETN x 980 =
SHARED DN DIGITAL CENTREX _____ _____ _____

(LARGE GROUP) (1020, if RSM)

Number of calls originated from, or terminated to, a shared DN

of a BRI/DSL or a multipoint BRI/DSL. (From 9 to 32 members.)

33. NUMBER OF CALLS FROM x 45 =

PACKET SWITCH DATA _____ _____ _____

ORIGINATIONS

Number of packet switch data calls per hour (including on-demand

B-channel packet switch data calls) originating from, but not

terminated to, the SM or RSM.

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34. NUMBER OF CALLS WHICH USE 265 =

CIRCUIT SWITCH DATA _____ _____ _____

(290, if RSM)

Number of featureless circuit-switched data calls per hour originating from or terminating at the SM or RSM.

35. NUMBER OF CIRCUIT-SWITCHED DATA x 310 =

CENTREX CALLS _____ _____ _____

(335, if RSM)

Number of times per hour that circuit switched data calls originated from or terminated to this SM with at least one of the following features assigned: hunt group/transfer, MLHG queuing, ARS, PFA, authorization code, account code, ICLID, or MDR.

APPLICATION PROCESSOR

Items 36 and 37 are applicable only if the AP is attached to the switch by BRI/DSLs. (The AP may be attached to any SM on the switch.) The real-time consumption for these items is the SMP real time spent on processing messages between the user's ISDN CPE and the SMP. If the AP is connected to the SM, the SMP real time spent on processing messages between the AP and the AP associated system process can be found in items 20 through 24.

36. NUMBER OF CALLS FROM x 280 =

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AP USERS (WITHOUT _____ _____ _____

40-CHARACTER DISPLAY TERMINALS)

Number of times per hour that ISDN users without 40-character display terminals initiate an EDS or MSS session at the SM or RSM.

37. NUMBER OF CALLS FROM x 360 =

AP USERS (WITH _____ _____ _____

40-CHARACTER DISPLAY TERMINALS)

Number of times per hour that ISDN users with 40-character display terminals initiate an EDS or MSS session at the SM or RSM.

DIGITAL ATTENDANTS

38. NUMBER OF CALLS WHICH USE x 895 =

DIGITAL ATTENDANT _____ _____ _____

(920, if RSM)

Number of times per hour that attendant 1- and 2-way calls split with bridge are made. This item is applicable if attendants using ISDN consoles are located on the SM or RSM.

39. NUMBER OF CALLS WHICH USE x 195 =

DIGITAL MESSAGE SERVICE _____ _____ _____

SYSTEM (MSS) ATTENDANT (220, if RSM)

Number of times per hour that attendant MSS call coverage calls

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are made on this SM or RSM. The assumption is that the digital MSS attendant is always logged onto the AP by way of a packet or circuit switch data call to monitor or insert messages. This item is applicable if attendants using ISDN consoles are located on the SM or RSM.

40. NUMBER OF CALLS WHICH USE x 310 =

ACD/BRCS AGENT _____ _____ _____

Number of calls per hour terminating to, or originating from, ACD/BRCS agents on this SM or RSM.

Note: If the SM has OSPS/CACD traffic as well as ACD/BRCS traffic, the call counts for both types of ACD traffic can be combined in this item. However, this worksheet does not account for any other OSPS traffic, and therefore, if other OSPS traffic exists on this SM, the worksheet will not provide an accurate result for the call capacity of this SM.

Sum of YOUR INPUT (items 6 through 40) ==> |C: |

Sum of SM REAL-TIME CONTRIBUTION (items 6 through 40) ==> |D: |

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_____

_____

YOUR SM OR RSM CALL CAPACITY AT 90 PERCENT OCCUPANCY

Enter A and B as decimal fractions in these formulas.

SMP1

In the SM equipped with SMP1, within 1 hour the SM call capacity

at 90 percent occupancy is:

3,6000,000 x (0.90-(1.18 x **B**_____))

_____ = _____ calls per hour

D_____

1.28 x 2 x _____

C_____

SMP12 (or SMP1 with SPEEDUP)

In the SM equipped with SMP12 (or SMP1 with SPEEDUP), within 1

hour the SM call capacity at 90 percent occupancy is:

3,600,000 x (0.90 - **B** _____)

_____ = _____ calls per hour

D _____

2 x _____

C _____

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SMP12 (or SMP1 with Speedup) provides the following performance improvements over SMP1: reduction of no-load occupancy by 15 percent, approximately 22 percent reduction in real time per call, and approximately 37 percent increase in overall call capacity.

SMP20

In the SM equipped with SMP20, within 1 hour the SM call capacity at 90 percent occupancy is:

$$\frac{3{,}6000{,}000 \times (0.90 - (0.63 \times \mathbf{B}\ _____))}{\mathbf{D}\ _____} = _____ \text{ calls per hour}$$

$$0.59 \times 2 \times \frac{}{\mathbf{C}\ _____}$$

SMP20 provides the following performance improvements over SMP12 (or SMP1 with SPEEDUP): reduced no-load occupancy by 37 percent, approximately 41 percent reduction in real time per call, and approximately 95 percent increase in overall call capacity.

SMP20 WITH DATA CACHE

In the SM equipped with SMP20 with data cache, within 1 hour the SM call capacity at 90 percent occupancy is:

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3,6000,000 x (0.90 - (0.48 x **B** _____))

_____ = _____ calls per hour

D _____

0.59 x 2 x _____

C _____

SMP20 with data cache provides the following performance improvements over SMP20: reduced no-load occupancy by 23 percent, approximately 33 percent reduction in real time per call, and approximately 57 percent increase in overall call capacity.

SMP23

In the SM equipped with SMP23, within 1 hour the SM call capacity at 90 percent occupancy is:

3,6000,000 x (0.90 - (0.58 x **B** _____))

_____ = _____ calls per hour

D _____

0.47 x 2 x _____

C _____

SMP23 provides the following performance improvements over SMP20:reduced no-load occupancy by 7 percent, approximately 20 percent reduction in real time, and approximately 27 percent increase in overall call capacity.

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Note: If these calculations indicate a call capacity occupancy greater than 90 percent, consider deloading the SM/RSM.

PERCENT OF CALL CAPACITY USED BY THE OFFERED LOAD

SMP1

If your SM is equipped with SMP1, the percent of the SMP1 call capacity used by the offered load is:

$$\frac{1.28 \times \mathbf{D}}{3{,}6000{,}000 \times (0.90 - (1.18 \times \mathbf{B}))} = \text{calls per hour}$$

SMP12 (or SMP1 with Speedup)

If your SM is equipped with SMP12 (or SMP1 with SPEEDUP), the percent of the SMP12 call capacity used by the offered load is:

$$\frac{\mathbf{D}}{3{,}600{,}000 \times (0.90 - (\mathbf{B}))} \times 100 = \text{percent}$$

SMP20

If your SM is equipped with SMP20, the percent of the SMP20 call capacity used by the offered load is:

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0.59 x **D** _____

_____ x 100 = _____ percent

3,600,000 x (0.90 - (0.63 x **B**_____))

SMP20 with Data Cache

If your SM is equipped with SMP20 with data cache, the percent of the SMP20 call capacity used by the offered load is:

0.39 x **D** _____

_____ x 100 = ____ percent

3,600,000 x (0.90 - (0.48 x **B**_____))

SMP23

If your SM is equipped with SMP23, the percent of the SMP23 call capacity used by the offered load is:

0.47 x **D** _____

_____ x 100 = _____ percent

3,600,000 x (0.90 - (0.58 x **B**_____))

Where:

B = No-load capacity

C = Total number of (O+T) calls per busy hour

D = Total real time used by the offered load.

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10.3 SWITCHING MODULE MEMORY

10.3.1 DESCRIPTION

The switching module (SM/SM-2000) and remote switching module (RSM) memory contains software releases and data [static and dynamic office dependent data (ODD)] necessary to perform most of the call processing functions.

The SM/SM-2000 processor (SMP) is fully duplicated and is operated in an active/standby configuration. In the normal configuration, the active SMP controls the entire SM/SM-2000, and keeps the data areas in the standby processor updated.

Memory for each SMP is supplied in the following two forms:

(1) Read-Only Memory (ROM) - The ROM contains data that is preset at manufacture. The ROM data is not lost if power is temporarily removed.

(2) Random-Access Memory (RAM) - The RAM contains data that can be changed under program control. The RAM data is lost if power is temporarily removed.

Most SM/SM-2000 programs are kept in RAM with backup provided on disk at the administration module (AM). The backup programs are transmitted over the network control time slot (NCT) links from the AM processor when the system is initialized, when a new software release is loaded, or when program integrity is suspect. An RSM engineered to provide stand-alone billing has an additional amount of memory to temporarily store automatic message accounting (AMA) records.

NOTE: The information in this section applies to the SM only.

10.3.2 ENGINEERING CONSIDERATIONS

Components of SM/SM-2000 memory size are as follows:

- Software Release (also known as text)
- Unprotected ODD (also known as dynamic ODD)
- Nonredundant ODD (part of static ODD)
- Redundant ODD (part of static ODD)
- Stand-Alone Billing
- Unallocated memory.
- Real Time Billing
- Peripheral Options

10.3.2.1 Software Release

The software release (or text) is the code that runs the SM/SM-2000. The size is different for different SM or SM-2000 configurations. Note that the text size grows from software release to software release because the amount of code to support new features increases from release to release.

10.3.2.2 Unprotected ODD

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The Unprotected ODD (UODD) is the dynamic data for storing transient call information, such as equipment status, or call status at any given time during the process of a call. Unprotected ODD is a variable value (not assigned a specific size) UODD is not backed up on disk.

10.3.2.3 Nonredundant ODD

Nonredundant ODD (NRODD) and redundant ODD (RODD) are known as static ODD. These data are considered static because they can only be changed by human intervention such as through recent change. As the name implies, NRODD is different in every SM/SM-2000. The information stored in NRODD is the feature information on individual phones such as:

- What features each subscriber purchased
- Speed call lists
- Call forwarding information
- Screen lists for Local Area Signaling Services
- Individual dialing plans.

The NRODD grows from release to release with the addition of new features. The NRODD also grows if new lines are added to the SM/SM-2000 because feature information on those lines are to be stored here. SM/SM-2000 ODD engineering is based upon anticipated changes in the static, nonredundant SM/SM-2000 ODD sizes. NRODD is backed up on disk.

10.3.2.4 Redundant ODD

Redundant ODD (RODD), part of static ODD, consists of information needed to route calls between SM/SM-2000s. It is redundant in every SM/SM-2000. Examples of redundant ODD are as follows:

- Office dialing plans
- Rate and route table
- Division of revenue data.

The RODD increases if new rate or route information is added. One copy of RODD is backed up on disk.

10.3.2.5 Stand Alone Billing

Stand-Alone Billing (SAB) is the area used to store billing information if the SM/SM-2000 is in stand-alone mode. Fifty kB is automatically added for SAB in every SM/SM-2000, but additional SAB memory can be added. To use the 50 kB or to add additional SAB, the SAB Right-to-Use fee must be purchased.

10.3.2.6 Unallocated Memory

Total SM/SM-2000 memory is the sum of text, UODD, NRODD, RODD, SAB, and Peripheral Options. The remaining memory between the total memory required and the end of the memory board, is the unallocated memory available for future growth of NRODD and RODD. If additional SAB is used, all unallocated memory is assigned to SAB; however, UODD, NRODD and RODD can still be grown. The memory is taken from SAB as if it were unallocated memory. When unallocated memory is exhausted, additional memory boards need to be ordered.

10.3.2.7 Real Time Billing

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SM memory is allocated for real-time billing function .

10.3.2.8 Peripheral Options

Peripheral image optioning reduces SM/SM-2000 memory size by eliminating text code for peripheral units not equipped in the SM/SM-2000 being pumped.

10.3.3 ASSIGNMENT GUIDELINES

The most efficient way to utilize SM/SM-2000 memory is to avoid replicating data in the SM/SM-2000 whenever possible. This is accomplished by limiting the distribution across SM/SM-2000s of IDP groups, shared speed-call groups, and other shared data. Refer to 235-190-XXX series documents for further details.

It is necessary to give more consideration to the sequential assignment of other parameters. This is because many translations have moved from the AM to the SM/SM-2000 and because other previously hashed relations are now accessed by the compacted-index method. Table 10.3-1 identifies these parameters and provides the guidelines for group sizes. If group number assignments are skipped, the omitted numbers should be in multiples of the group size indicated. For example, charge index assignments could be in ranges of 0 through 15, 32 through 47, and 128 through 144. The numbers in the ranges of 16 through 31 and 48 through 127 are not assigned. Also refer to the assignment guidelines previously provided for the AM.

Table 10.3-1 SM Sequential Assignment Guidelines

PARAMETER	GROUP SIZE
Screening indexes	64
Code indexes	128
POTS route indexes	21
BRCS route indexes	9
Charge indexes	21
Call pickup groups	64

Multiline hunt groups affect real-time usage and memory within an SM/SM-2000. These groups must be spread in limiting SM/SM-2000s because of the redundancy of memory. Unless an MLHG has uniform call distribution (UCD), terminal 1 receives the heaviest usage, then terminal 2, etc. If the MLHG does not have UCD, the MLHG should be assigned with terminal 1 having the highest priority class of service. Terminal 2 should have the next lower priority, etc.

Because memory is also involved with the MLHGs, the same scheme as used in BRCS IDP group should be used.

Although normalized office codes (NOCs) and telephone numbers do not require assignment in groups, it is best to assign them sequentially whenever possible. In the case of telephone numbers, hundreds groups should be filled before opening new hundreds groups.

Additionally biginning with software release 5E6, SM/SM-2000 memory may be saved through the use of BRCS feature groups (BFGs) as shown below:

MFT ABBREVIATION	FEATURE TYPE	POTENTIAL SM MEMORY SAVINGS PERCENTAGE
CPI	Calling Party Number/ Billing Number	100
HI	Home Intercom	100
ID	Individualized Dialing (Replaces IDP) [a]	0
SC	Speed Calling	**b**
SCA	Local Area Signaling Services - Selective Call Acceptance/ Computer Access Restriction	100

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SCF	Local Area Signaling Services Selective Call Forwarding	100
SCR	Local Area Signaling Services Selective Call Rejection	100
SDA	Local Area Signaling Services Selective Distinctive Alerting	100

Notes:

a. The IDP modular feature type was available prior to 5E6 software release.

b. An indeterminate amount of speed calling memory savings results from BFG use. The actual memory savings depends upon how speed calling is implemented. The use of shared and unshared speed calling lists changes memory savings potential. Shared speed calling lists use 30-50% less memory than unshared speed calling lists.

For detailed information on modular feature types, refer to 235-190-101 *Business and Residence Modular Features*.

10.3.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

There are no dedicated measurements for monitoring SM/RSM memory usage. The OP:ODD command provides the necessary usage determination method as previously described. Additionally, the major and minor alarms provide the only types of service indicators.

10.3.5 FEATURE IMPACT

Memory usage in an SM/SM-2000 or RSM may be impacted by feature penetration. For further details concerning these and other features and how they impact the current software release, refer to the memory worksheets in this manual.

10.3.6 MEMORY MANAGEMENT

Memory can be sized and administered by communities to achieve additional efficiency. The following communities may be considered:

- ORMs
- RSMs
- RSM clusters
- All other SM/SM-2000s
- SM/SM-2000s with heavy BRCS penetration.

10.3.6.1 SM Memory Engineering

Some offices may require more than the physical memory requirement per SM configurations (per SR). The variance in total Office Dependent Data (ODD) between offices is growing exponentially due to changes in the marketplace. As customers incorporate changes such as turning offices into "virtual" switches by assigning specific hundreds groups of screening indexes to resellers, for example, the amount of Redundant ODD (RODD) increases at a rate never seen before. In other words, translations for routing and screening are being used in "new" ways. As more and more routing and screening data is required with the new competitive environment, more RODD will be required. For these reasons, Lucent is looking for ways to better estimate memory requirements. The existing planning algorithms may need to be changed to account for the wider spread in ODD. Memory requirements for all configurations (especially Basic, Standard, & Loaded) are being investigated. New memory requirements for these configurations are provided, as they become available.

Total Memory required = Text + NRODD + RODD + UODD + RTBM + SABM + PO.

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In order to determine the total amount of memory required, the OP ODD report lists the existing NRODD, RODD, UODD, RTBM, and SABM. The missing parts are text size and PO sizes. Base text size is determined by the software configuration. The OP MEMSIZE report will list the software configuration for all SMs in the office. The configuration to size is a look-up function in this command.

10.3.6.2 Projecting SM Memory Requirements

With Software Release 5E9(2) or higher, the OP:MEMSIZE, to release = "5E???" command can be used to project memory requirements from release to release. When this command is run, it will determine the amount of Free Space that will be set on retrofit. It will decrement Free Space by 1% increments in order to allow retrofit in existing, equipped memory. If the amount of Free Space determined is not satisfactory, the following may be implemented:

- Grow memory
- Rerun "OP:MEMSIZE" to reset the values before proceeding with the retrofit.

NOTE: The tool was changed for 5E12 and will always enforce the required "Engineered" size if it is the largest of the equipped, projected or engineered sizes.

This tool should be run well in advance of the Telephone Equipment Order (TEO) due date (-13 to -11 weeks). Once an office has added the necessary memory, the tool must be run again before the retrofit.

10.3.6.3 Free Space Allocation

As part of ODD requirements, a certain amount of "Free Space" must be allocated in both RODD and NRODD. These changes are necessary as an office grows and changes. Free Space for these two areas of memory is reset upon retrofit to a default of 30% unless otherwise specified. (An acceptable range is between 25% to 40%.). Free Space of 20% or less will result in minor office alarms. Both NRODD and RODD must have at least .25 MB of Free Space.

10.3.6.4 Adjusting Free Space

While FREE SPACE can be adjusted, unless it is otherwise specified to the Lucent Regional Engineer, or as adjusted to complete the retrofit by OP:MEMSIZE, a retrofit will use a 30% value for FREE SPACE. The following should be considered:

- · The amount of free space should not be too high because of daily ODD backups and initial boots (it takes time and disk space to back up zeros).
- Free space should not be too small (enough space is required to accommodate growth data, e.g., adding line data in the field).
- Once the free space is completely used with ODD growth messages and more is required, additional memory will be taken from the unallocated memory area.

Increasing FREE SPACE also results in less UNALLOC (unallocated) memory. Once UNALLOC memory is assigned, (except for Peripheral Optioning) it cannot be reassigned -- something that should be seriously considered before adjusting the FREE SPACE value. If you degrow a Peripheral Option hardware, you can degrow the associated memory requirements. This will increase UNALLOC memory.

Another effect of adjusting FREE SPACE is that both "USED" and "AVAIL" RODD and NRODD is backed up on disk -- even if there is no "real" data present. This can potentially result in significant disk usage. A decision to adjust the FREE SPACE should be made after careful consideration and thoroughly documented as to why free space was adjusted.

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10.3.6.5 Total SM Memory Requirements

When you are calculating SM memory requirements, add the values for **Text + NRODD + RODD + UODD + RTBM + SABM + Peripheral Options**. When you are retrofitting to a new software release, you can find the existing values for all the above areas except Text and Peripheral Options in the OP:ODD Report that is available from the switch.

10.3.6.6 Static ODD

The following is a list of general tips that may assist in the management of memory.

- Screening entries are not needed for unused prefixes.
- Packing can be optimized for indexed relations by sequentially numbering groups and members.
- PBX Direct Inward Dialing (DID) telephone number assignments require careful consideration. Generally, there are three ways to assign PBX DID lines: by individual lines, by hundreds group, or by the local digit interpreter table (LDIT) or incoming digit interpreter table (INDIT). There are advantages and trade-offs associated with each of these methods as described as follows:
  - PBX DID telephone numbers translated in the LDIT or office dialing plan (INDIT) require less memory than directory number tables. However, verification of these lines cannot be performed based on the telephone numbers (only by information on LDIT or INDIT forms).
  - Assignments made on individual lines use a large amount of memory, but verifications are easily performed.
  - Assignments made based on the hundreds group use memory efficiently and are relatively easy to verify.
- Limiting the distribution across SM/SM-2000s of IDP groups and shared speed call groups reduces data duplication and, therefore, saves memory.

During periods of high RC activity, tuples entered into hashed relations may be placed into secondary overflow which is linearly searched. This indicates the need for a reorganization (memory reorganization), as the relations are in overflow. Although a reorganization should be scheduled for automatic execution each day, heavy RC activity may require a manual reorganization. This is done through the use of the EXC:REORG input message from the MCC or SCCS. It may be necessary to first allow the reorganization by the ALW:REORG command, although reorganization should normally be in the allow state. For further details on the use of this message and the system response, refer to Input Message Manual 235-600-700 , and 235-600-750, Output Message Manual. Further information concerning reorganization can also be found in 235-105-220, Corrective Maintenance Procedures.

Should the reorganization fail, it is probably due to insufficient room in the allocated area of memory in that SM/SM-2000 or RSM. The mechanism of reorganization moves one data base relation at a time from the used area to the available area in the SM/RSM, performs the reorganization, and frees the space previously used by the relation. This results in a reduction of the number of pages of secondary overflow of the relation, as well as reducing the size of used memory area. If the relation is too large for the allocated area, the reorganization will fail.

To obtain the status of memory allocation in the office, the following input requests can be made.

- To determine which relations may need reorganization:
  - INH:REORG

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- EXC:REORG.

The result of these commands is a printout of the relations needing reorganization. When this is completed, the automatic reorganization should be allowed with the ALW:REORG command.

- To determine the amount of static ODD space currently used, enter the OP:ODD message.

These messages are input from the MCC or SCCS and cause a report to be generated for each SM/SM-2000 or RSM and the AM. For further details concerning these messages, refer to 235-600-700 and 235-600-750. The report provides the following information:

- The number of 128-byte memory blocks used
- The number of 128-byte memory blocks available with the current allocation. (There may be additional memory present which can be allocated.)
- Percent of the currently allocated memory used.

The percent of memory used is calculated by dividing the number of blocks used by the total of the blocks used and the blocks available. This sum of used and available blocks is the value of a parameter called DBPHYSBLKS.

The *5ESS*® switch data base management (DBM) subsystem automatically stores the ODD on pages (areas of storage 128 to 8,192 bytes long) within memory of the AM and the SM/SM-2000s. As lines and trunks and other services are added to the *5ESS*® switch, ODD memory requirements may increase. Because ODD data items are stored in pages, the memory requirement is a function of the number of pages used and their sizes rather than a direct relationship to the number of lines, trunks, or services supported. For example, because of line assignment guidelines, adding POTS lines typically does not increase SM/SM-2000 ODD.

Since changes in the ODD impact its size, ODD memory should be monitored. This is particularly true of the SM/SM-2000 ODD which may exceed the engineered size and require the allocation of more space or even the installation of more memory boards. The size of ODD memory should be checked periodically, such as before and after any memory impacting growth procedure is performed. These growth procedures include:

- Heavy feature growth.
- Any addition of digit analysis, such as changes which require more digits to be translated.
- Additions to the screening table.
- The addition of new IDP groups to the SM/SM-2000. This is particularly true if there is a large amount of private digit analysis required for the IDP group. The addition of a new IDP group is defined as the addition of the first member line or trunk to the SM/SM-2000. Further information concerning the implementation of new IDP groups may be found in 235-190-XXX series documents.

For further details concerning the impact on memory by feature and hardware growth procedures, refer to the memory worksheets.

Generally, the SM/SM-2000 static memory should be monitored. There must be enough memory provided to allow reorganization. The memory monitoring tool (OP:ODD) may be used to monitor static ODD memory in the SM/SM-2000s and RSMs.

Unallocated memory or available memory should be about 500 kB for best switch operation. If engineering

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this space requires another SM memory board, ensure that at least 200 kB of available memory is provided at the end of the engineering period. This may save the expense of the additional memory board. If disk space is available for backup copies of SM/SM-2000 ODDs, and extra space is not required for stand-alone billing, ODD memory may be allocated to the maximum amount possible given the memory board equipage. Consideration should be given to SM/SM-2000 additions when determining needed backup disk space.

10.3.6.7 Dynamic ODD

Dynamic ODD, also known as UODD, is sized based on the type of SM/SM-2000 memory image. For example, a Loaded SM/SM-2000 serving ISDN or OSPS has more UODD allocated than a Standard or Basic SM. An SM/SM-2000 serving hundreds of ISDN BRI/DSLs uses more UODD than an SM/SM-2000 serving a small number of BRI/DSLs. The purpose of having two UODD sizes is to conserve SM memory for the vast majority of SM/SM-2000s which have fewer than 1,024 ISDN lines assigned. The allocation of the SM/SM-2000 UODD is performed by the ODA process. The OP ODD report provides information on AM, SM/SM-2000, and CMP.

10.3.6.8 Stand-Alone Billing

In the 5E5 and later software releases, all SM/SM-2000s; including RSMs, ORMs, host SMs (HSMs), and 2-mile ORMs (TRMs) can have the stand-alone billing option.

A minimum of 50 kB of memory is dedicated to stand-alone billing memory on an SM, and 740 kB on an SM-2000. Allocated memory for ODD is located immediately before the stand-alone memory. Any unallocated memory is located immediately after stand-alone memory.

The SM/SM-2000 unprotected ODD (UOOD) memory growth is performed by moving the starting address of the SM/SM-2000 nonredundant ODD (NRODD) into higher memory by the ST:UODDGRW input message. However, the ending address of the NRODD remains unchanged. Therefore, the UODD growth is limited in size by the amount of available memory available within the NRODD. The SM/SM-2000 UODD growth should be executed only in rare circumstances because the SM/SM-2000 UODD is already engineered to be sufficient for most offices.

The NRODD growth increases the amount of memory allocated to the NRODD by shifting the entire redundant ODD (RODD) and stand-alone billing areas into higher memory. This is accomplished through the use of the ST:NRODDGRW input message.

The RODD growth shifts all stand-alone billing area into higher memory through the use of the ST:RODDGRW input message. The RODD growth occurs simultaneously on every SM/SM-2000.

The "unallocated" memory space is free for UODD,NRODD, RODD, or stand-alone billing growths to acquire. However, when the unallocated space has been used completely, no further UODD, RODD, NRODD, or stand-alone billing growths can occur without memory board growth or reduction of stand-alone billing memory. Specifying a growth size larger than the unallocated size in an SM/SM-2000 results in a corresponding reduction in the allocated stand-alone billing space (up to the last 50 kB on an SM, and 740 kB on an SM-2000) since NRODD and RODD have priority over stand-alone billing. Note that the growth will fail if an attempt is made to grow ODD into the 50 kB dedicated to stand-alone billing.

Reducing the stand-alone billing space results in the SM/SM-2000 being able to store billing information for a smaller period of time if the SM/SM-2000 should be forced into the stand-alone mode. If there is not enough memory in the unallocated space to grow SM/SM-2000 NRODD or RODD, then the traffic or equipment engineer should be consulted to order additional memory. Detailed ODD growth procedures can be found in 235-105-210.

By using the CFR:SAMEM input message, stand-alone billing growth increases the amount of memory allocated to stand-alone billing by allocating all unallocated memory. Note that stand-alone billing memory is not in use when this allocation occurs. Thus, the OP:ODD output message shows unallocated

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(UNALLOC) memory as 0 bytes and adds the formerly unallocated memory to stand-alone billing memory (SABM). The VFY:SAMEM input message may be used to verify the amount of allocated stand-alone billing memory. Refer to Input Message Manual, 235-600-700 and Output Message Manual 235-600-750 for details on the CFR:SAMEM, OP:ODD, ST:NRODDGRW, ST:RODDGRW, ST:UODDGRW, and VFY:SAMEM messages.

The amount of memory dedicated for stand-alone billing data is dependent on the expected number and type of billed calls and the expected duration of stand-alone operation.

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10.4 SM MEMORY WORKSHEET HARDWARE AND FEATURE GROWTH

10.4.1 Note

When transitioning to a new software release, it is advisable to review all subsequent software release information in order to determine future growth considerations.

10.4.2 5E14 SOFTWARE RELEASE

10.4.2.1 HARDWARE

10.4.2.1.1 AM

10.4.2.1.1.1 3B20D AM

The 3B20D AM is not supported in the 5E14 software release.

10.4.2.1.1.2 3B21D AM

The AM is currently equipped with 128MB of memory via a 32 MB core board and three 32 MB Single In-Line Memory Module (SIMM). This is an increase over previous software releases.

10.4.2.1.1.3 New Memory Issues

The reasons for the increase in 5E14 AM memory are primarily attributed to the following:

- Deregulation features and applications (such as Local Number Portability , Switch Unbundling, and Long Distance Platform) are requiring additional memory to support new and expanded office-dependent data (ODD) structures.
- To meet our customers time-to-market expectations, more features are being delivered as software updates SUs). As we continually improve productivity in software development and deploy larger and more frequent features via the Software Update process, more memory will be required in the base hardware configuration.
- Introduction of Rapid Software Delivery features.

10.4.2.1.2 Switching Module (SM)

Table 10.4-1 shows the 5E14 SMPU configurations.

Table 10.4-1 5E14 SMPU Configurations

PROCESSOR [a]		MEMORY BOARDS [b]	MAX. SLOTS [c]	MAX. EQUIPAGE (MB) [d]
SMP23CDMX	68020	TN1423 TN2012		52 5
SMP20 SMP20DC	68020	TN1374 TN1376 TN1661	6 6 6	24 48 96
CORE40	68040	TN1685 TN1806	4 2	128 256
CORE60	68060	TN1685 TN1806	4 2	192 256
SB20CORE	68LC040	KBN20 KBN21 KBN22	1 MM 2 MM 3 MM	 32 64

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				96
CORE60MM UN 588	68060	TN1685 TN1806	2 2	192 256

Notes:

a. Processor addressability limits: 68012 & 68023 - 32 MB, 68020 - 4 GB,SB20CORE/ CORE40 /CORE60 - 748 MB.

b. TN56 = 2MB, TN2012 = 4 MB, TN1374 = 4 MB, TN1376 = 8 MB, TN1661 = 16 MB, TN1685 =32 MB, TN1423=32 MB, TN1806 = 64 MB. The TN1374, TN1376, TN1661 boards may be mixed in the same MCTU2 (68020). The other boards are not mixable. The TN1423 is a new microprocessor board with dynamic memory. The TN1685 and TN1806 can be mixed in the same CORE40/60. or CORE60MM. The CORE40 has no memory on the processor board; the CORE60 has 64MB on the board, and the CORE60MM can be equipped with 64 MB or 128 MB of memory

c. Max slots for CORE60 assumes SM-2000 unit. Max slots for CORE60MM assumes SM2005 unit.

d. Maximum equipage (**) requires the use of the MEU (Memory Expansion Unit). Memory totals denote DRAM on processor pack plus all external memory packs

e. The TN1423 is a processor board which supports 32 megabytes of on-board memory; the SMP23CDM does not support external memory boards, the SMP23CDMX supports zero to five TN2012 external memory boards.

10.4.2.1.2.1 TN1423 Microprocessor Board (Feature SMP23CDM)

This feature is also known as SMP23CDM (provided in 5E10) for SMP23 Dynamic Core Memory and provided 32 MB of memory. The feature was ported back to 5E9(1) software release so that offices skipping from 5E9(1) to the 5E10 software release could use it. It was also ported to the 5E9(2) software release because it needs to be added before any retrofit to 5E10. This feature supports the conversion from the SMP12 to TN1423. Prudent use of this board can save money when growing memory. The TN1423 is priced slightly higher than the cost of an MEU and one TN2012. When this board is installed in SMs equipped with TN2012s, the five TN2012s can be used to grow memory in other SMs with MEUs or a few MEUs may be ordered to grow memory in some SMs using the surplus TN2012s.

10.4.2.1.2.2 SMP23CDMX

The TN1423 in combination with the TN1408 , the TN1418 and appropriate wiring upgrade comprise the SMP23CDMX. This combination permits the TN1423 to use external memory packs.

10.4.2.1.2.3 Module Control Time Slot Interchange Unit Version 3 (MCTU3)

Non-SM-2000 SMs shipped equipped with the MCTU3 that has a 68LC040 processor (beginning with 5E10 software release update). The MCTU3 has all the existing functionality of the SMP20 plus additional capabilities. It is a one-shelf unit, instead of the two-shelf unit (MCTU2) needed for the SMP20.

10.4.2.1.3 SM-2000 Memory

As part of the 5E11 software release update, a new backplane and compressed shelving is shipped with all new offices. The compressed unit is known as the SMPU5. The CORE60 was shipped with the SM-2000 in all 5E11 orders, regardless of whether the SMPU4 or SMPU5 is equipped. The SMPU4 is equipped with four memory slots. The SMPU5 is equipped with two memory slots. The CORE60 is equipped with the first 64 MB of memory attached to the processor core board. With 128 MB required, two TN1685s can be used or one TN1806. ***Note: If two TN1685s are used in the SMPU5, both memory slots are equipped.*** Note that if an upgrade from a CORE40 to a CORE60 will be ordered for improved real time, some of the 32 MB memory packs will no longer be needed as the CORE60 comes with 64 MB on the processor board.

10.4.2.1.3.1 CORE60MM

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The CORE60MM is designed to improve the processor performance and provide two CORE RAM memory configurations of either 64MB (UN594) or 128 MB (UN588). The hardware and associated software for the CORE60MM are designed to improve the speed of the SM-2000 Switching Module by a factor of 1.8 over the CORE40. The 64MB CORE60MM (UN594) is supported on SM-2000 for software release 5E12. The 128 MB CORE60MM (UN588) is supported on SM2005 for release 5E12. The 128MB CORE60MM (UN588) will be used for all newly shipped SMPU5 offices.

10.4.2.2 SOFTWARE

10.4.2.2.1 Switching Module (SM)

With Software Release 5E14, there are five software configurations: basic, standard, loaded, signaling, and SM-2000. Signaling is a software configuration for VCDX offices equipped with an SM that support SS7 signaling on a packet switch unit (PSU). The signaling configuration has everything from the loaded configuration plus the ability to do SS7 signaling.

10.4.2.2.1.1 Peripheral Image Sizes for 5E14

Table 10.4-2 5E14 Image Sizes and Configuration Support

IMAGE	KB	BASIC	STANDARD	LOADED	SIGNAL	SM-2000
LDSU	92	□	□	□	□	
LDSF +DSC4	660	□	□	□	□	
RAF	80	□	□	□	□	
ISTF	60 + 42	□	□	□	□	
LDSU, RAF, ISTF **a**	42	□	□	□	□	
IDCU	742		□	□	□	□
GDSF	366	□	□	□	□	□
SAS	426	□	□	□	□	□
ISLU	474			□		
ISLU2	840			□	□	□
PI	218			□		
PI2	450			□	□	□
PH2	1472			□		
PH3	1156			□		
PH4	1666			□	□	□
SS7 on PSU	3992				□	□
PHV **d**	514			□	□	□
PHA **d**	514			□	□	□
PHV3C **d**	718			□	□	□
PHV4C **a**	1162			□	□	□
LDSF **b**	202					□
GDSF or LDSF **c**	202	□	□	□	□	□
DNUS	1054					□

Notes:

a. If the SM has LDSU, RAF, or ISTF, the 42 KBs is counted only once. Although LDSU was originally segregated as an option, most SMs will require this option. The few SMs that will NOT require this option are SMs that are only equipped with the older LDSU1. The LDSU1 does not support SS7 functionality.

b. LDSF Functionality is provided with all SM-2000 SMs. Therefore, if you have SM-2000, you will need LDSF with 202 kB and the additional 202 kB if you have GDSF, or LDSF.

c. If the SM has GDSF or LDSF, the 202 kB is counted only once. This code supports the DSC3 functionality.

d. For CDMA in wireless offices only.

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10.4.2.2.1.2 Variable UODD

Another change from previous releases is the sizing of unprotected office dependent data (UODD). In software releases prior to 5E9(2), UODD had a fixed size for each SM software configuration. UODD is a variable number. The size varies based upon the specific features and number of lines supported in static ODD (non-redundant and redundant). For example, in the 5E8 software release, the UODD for all Basic SMs was one fixed size of 1304 KB. Now, each SM has a unique size. The office data assembler (ODA) checks all static relations and totals the UODD required to support those static relations. There is a fixed association between the static data and the related relations stored in UODD.

10.4.2.2.2 Memory Engineering Guidelines

Some 5E14 offices may require more than the physical memory requirement per SM configurations. The variance in total office dependent data (ODD) between offices is growing exponentially due to changes in the marketplace. As customers incorporate changes such as turning offices into "virtual" switches by assigning specific hundreds groups of screening indexes to resellers, for example, the amount of redundant ODD (RODD) increases at a rate never seen before. In other words, translations for routing and screening are being used in "new" ways. As more and more routing and screening data is required with the new competitive environment, more RODD will be required. For these reasons, Lucent is looking for ways to better estimate memory requirements. The existing planning algorithms may need to be changed to account for the wider spread in ODD. Memory requirements for all configurations (especially Basic, Standard, and Loaded) are being investigated. New memory requirements for these configurations are provided as they become available.

The following are the memory engineering guidelines for each of the SM configurations. For each configuration, the software release text (non-ODD) requirement without any optional peripherals and with optional peripherals is given with the default ODD sizes.

Total memory required = text+NRODD+RODD+UODD+SAB+PO.

In order to determine the total amount of memory required, the OP ODD report lists the existing NRODD, RODD, UODD, and SAB. The missing part has always been the text size and now the PO sizes. Base text size is determined by the software configuration. The OP MEMSIZE report lists the software configuration for all SMs in the office. The configuration to size is a look-up function in this command.

The command DUMP:SMMAP can be used to determine the POs that are equipped.

When using the following configuration information , you may refer to Table 10.4-1 for PO sizes. The total memory includes the text, ODD, and SAB listed in the description plus the PO value in the table to determine the total memory (in MB) required.

10.4.2.2.2.1 Basic SM

The 5E14 software release text base and patch sizes for the Basic SM are 22.65 MB + 5.42 MB = 28.07 MB. The ODD size for 90 percent of the Basic SMs in 5E14 is 10.13 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, and HDSU for a total of 1.66 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, and SAS for a total of 1.66 MB. Therefore, most Basic SMs will fit in 40 MB (actual) or less (40 MB physical). In SMs, the reserved SAB is 56KB.

10.4.2.2.2.2 Standard SM

The 5E14 software release text base and patch sizes for the Standard SM are 24.63 MB + 6.25 MB = 30.88 MB. The ODD size for 90 percent of the Standard SMs in 5E14 is 10.58 MB or less (9.13 MB or less for OSPS). The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, and IDCU for a total of 2.38 MB (1.66 MB for OSPS). The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, SAS, and IDCU for a total of 2.38 MB. Therefore, most Standard SMs will fit in 44 MB (actual) or less (44 MB physical). In SMs, reserved SAB is 56 KB.

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10.4.2.2.2.3 Loaded SM

The 5E14 software release text base and patch sizes for the Loaded SM are 32.10 MB + 9.78 MB = 41.88 MB. The ODD size for 90 percent of the Loaded SMs in 5E14 is 11.71 MB or less (10.61 MB or less for OSPS and 8.07 MB or less for TDMA/CDMA). The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, IDCU, ISLU, PI, PH2 and PH3 for a total of 9.94 MB. The POs for new ships are assumed to equipped with LDSU, HDSU, GDSF, SAS, IDCU, ISLU2, PI2, and PH4 for a total of 5.27 MB. The POs for CDMA retrofits are assumed to be equipped with LDSU, ISTF, HDSU, PI2, PH4, PHV, and PHA for a total of 5.10 MB. The POs for CDMA new ships are assumed to be equipped with LDSU, HDSU, PI2, PH4, PHV, PHA, LDSF, GDSF for a total of 6.15 MB. Since Loaded SMs will not equip all the POs, most SMs are projected to fit within 63 MB (actual) or less (64 MB physical). For OSPS, most SMs are projected to fit within 58 MB (actual) or less (60 MB physical). In SMs, reserved SAB is 56 KB.

10.4.2.2.2.4 Signaling SM

This software configuration has been added for SM and VDCX offices that wish to support SS7 signaling on a Packet Switch Unit (PSU). VCDX offices that do not wish to support SS7 signaling can use the loaded software configuration above. SS7 signaling on PSU requires PH3 protocol handlers.

The 5E14 software release text base and patch sizes for the Signaling SM are 34.09 MB + 10.61 = 44.70 MB. The ODD size for 90 percent of the Signaling SM in 5E14 is 11.05 MB or less (12.26 MB or less for VCDX) . The POs are assumed to equipped with LDSU, HDSU, GDSF, SAS, IDCU, ISLU2, PI2, PH3, PH4, and SS7 on PSU for a total of 12.56 MB (15.05 MB for VCDX) . The POs for a new VCDX are assumed to be a total of 11.59 MB.

Stand alone billing (SAB) memory has been added to the VCDX offices because they must provide the ability to hold at least 72 hours of billing data in stand alone mode. Since Signaling SMs will not equip all the POs, all SMs are projected to fit within 75 MB (actual) or less (76 MB physical). Wireline Signaling SMs are projected to fit within 69 MB (actual) or less (72 MB physical).

10.4.2.2.2.5 Stand Alone Billing Changes

There is a change taking place with Stand Alone Billing (SAB). This change is being made to enhance the management of memory. Actively managing SAB memory emphasizes the need to monitor memory that would store billing records for the duration of a stand alone. There is no change in that when SAB is set to "YES", all unallocated memory is dedicated to SAB. In the past, it was readily available at ODD growth time, "Auto Shrink". In the future, this memory **will not** be automatically available. SAB will need to be degrown by the amount needed or new memory added, "No Auto Shrink".

NOTE: There will also be an addition to the SM memory layout called Real Time Billing Memory (RTBM). A default amount of memory will be provided for every SM, whether or not the Long Distance Platform, Real Time Call Detail feature is utilized The default size is 8 KB for a SM and 288 KB for an SM-2000.

10.4.2.2.3 SM-2000

The 5E14 software release text base and patch sizes for SM-2000 are 42.78 MB. + 11.29 MB = 54.07. The ODD size for 90 percent of the SM-2000 is 53.01 MB or less (37.84 MB or less for TDMA/CDMA and 59.75 MB or less for VCDX).

The POs for service provider retrofits are assumed to be equipped with LDSF, DSC3, and DNUS for 13.55 MB. The POs for service provider new ships are assumed to be equipped with LDSF, GDSF, DSC3, DNUS, SAS, IDCU, ISLU2, PI2, and PH4 for a total of 6.26 MB.

The POs for a TDMA/CDMA retrofit are assumed to be equipped with LDSU (DSU2), LDSF+DSC4, ISTF, GDSF+DSC3, PI2, PH4, PHV1, and PHA1 for a total of 10.93 MB. The POs for CDMA new ships are

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assumed to be equipped with LDSF, GDSF, DSC3, DNUS, PI2, PHA, PHV, and PH4 for a total of 7.64 MB.

The POs for VCDX retrofits are assumed to be LDSF, GDSF, DSC3, DNUS, ISLU2, PI2, PH4, SAS, IDCU, and SS7 on PSU for a total of 16.04 MB. The POs for a VCDX new ships are assumed to be equipped with LDSF2+DSC4, ISTF, GDSF+DSC3 IDCU, ISLU2, PI2, PH4, PHV1, PHA1, and PHV3C for a total of 12.58 MB.

The SM-2000 is under 122 MB (actual) and 128 MB (physical). The VCDX SM-2000 is under 144 MB (actual) and 160 MB (physical). Note that DNU-S is a heavy memory consumer. Wireline SM-2000s can handle approximately two fully loaded DNU-S and the VCDX SM-2000 can handle three fully loaded DNU-S. The needs of SM UODD in particular must be taken into consideration. Note that the reserved Stand Alone Billing (SAB) in SM-2000 is 740 KB. Stand Alone Billing (SAB) memory has been added to the VCDX offices because they must provide the ability to hold at least 72 hours of billing data in stand alone mode.

Some SM-2000s require more than 128 MB of memory as early as retrofits to 5E13. This required memory is primarily due to the quick growth of trunks using DNU-S. This growth is primarily attributed to the UODD required to support all of the trunks. Recommendations to grow memory beyond 128 MB on a SM-2000 include:

- For 5E13 retrofits, any SM-2000s with ODD used (5E12 data) beyond 55 MB (total RODD + NRODD + UODD). Any SM-2000 with "UODD USED" at 40 MB or more should be monitored closely via OP:ODD.
- For 5E14 retrofits, any SM-2000s with ODD used (5E13 data) beyond 45 MB (ODD is reduced due to text increase). Any SM-2000 with "UODD USED" at 38 MB or more should be monitored closely via OP:ODD.
- Any SM-2000s that anticipate high growth during a software release (e.g., DNU-S, TR303, NOCs, lines, trunks, etc.).
- Notes: SAB/RTB needs to be considered with above. Unallocated threshold for an SM-2000 is being investigated.

For offices retrofitting from 5E13 to 5E14, the reference below provides recommendations for performing memory analysis beyond OP:MEMSIZE. Use of OP:ODD may determine whether a specific SM-2000 will make it through the 5E14 Software Release. Refer to Table 10.4-3 for determining whether or not it is necessary to grow SM memory beyond 128 MB (to a maximum of 192 MB). This table is especially helpful to progressive customers using many of the caveats (DNU-S, NOC Growth, etc.) articulated below the 5E14 software release memory. After using this table, engineers may wish to equip more than the 128 MB requirement for the 5E14 Software Release. The information pertains to all SM-2000s, especially those in the field more than one year.

This analysis also needs to take into account the following:

- Maturation of the SM-2000s
- Applications/features that may impact a SM-2000
- Line/trunk growth
- Translations activities including dialing plans and resources used (LDITS, DAS, etc.)
- Intended length of stay on the 5E14 Software Release.

Table 10.4-3 5E14 SM Memory Growth Analysis

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Tier	Tool/Indication	Recommendation [a]
1	OP:MEMSIZE (5E13 to 5E14) populates "MEMORY NEEDED" column with "YES"	Growth Required - Not growing memory will stop retrofit immediately during retrofit check tool run
2	OP:MEMSIZE (5E13 to 5E14) populates "FREE SPACE" with value below 30 percent (Grow down of NRODD below 30 percent specifically) and "MEMORY NEEDED" column with "NO"	Strongly Advise Growth - memory will not last entire stay on 5E14 software release.
3	OP:ODD (5E13 data) output shows two or three of the following: "ODD USED" total beyond 45 MB "UODD USED" beyond 38 MB "UNALLOCATED" below: [b] 12.5 MB (with a predicted 10 percent ODD growth); or below 16 MB (with a predicted 15 percent ODD growth)	Advise Growth - highly unlikely memory will last entire stay on 5E14 software release.
4	OP:ODD (5E13 data) output shows one or two of the following: "ODD USED" Total beyond 45 MB "UODD USED" beyond 38 MB "UNALLOCATED" below: [b] 16+ MB (predict 15 percent ODD growth)	May Need to Grow - potential is there to exhaust memory during course of stay on 5E14 software release.
5	OP:ODD (5E13 data) output shows: "UNALLOCATED" above 18 MB [b]	Probably Will Not Need to Grow - not likely to exhaust memory during course of stay on 5E14 software release.

Notes:

a. Growth beyond 128 MB equipage. Strongly recommend growing 64 MB boards to total of 192 MB

b. Number based upon 7.6 MB text/patch growth from 5E13 to 5E14 and historical/future ODD growth. For 5E14 new offices, consider the following: Use the latest version of DOPSMOD (stand-alone) and maintain the default of 192 MB. Also, specify 192 MB on all orders to guarantee sufficient memory through 5E14 and prepare for minimum 5E15 memory requirement of 160 MB.

10.4.2.3 ADMINISTRATION

10.4.2.3.1 Switching Module

10.4.2.3.1.1 SMMAP Command

The SMMAP command, is dump:smmap, sm=x When reading this command, the start and end address of each image and its associated hashsum (parity check for errors) is listed. Many of the peripheral images listed in Table 10.4-2 , are the sum of several individual images that come as a "family". Each member of the family and associated hash sum check are listed in the dump of the SMMAP command.

10.4.2.3.1.2 OP MEMSIZE Command

10.4.2.3.1.2.1 Description

The OP:MEMSIZE command can be used to project memory requirements from release to release. For example, if an office is on software release 5E10 retrofitting to software release 5E11, a software update is

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loaded which contains the memory projections for 5E11. When the command is run (i.e. using TORELEASE "5E111"), the new memory requirements are calculated and the hardware is checked to determine if additional memory boards are required before the retrofit. The command may also be used to monitor memory grow within a release (i.e. using TO RELEASE "5E101"). The command also lists on a per SM basis, the type and quantity of all memory packs, the software configuration, and whether additional Stand Alone Billing is set to yes.

10.4.2.3.1.2.2 Input

The OP:MEMSIZE input command is used to list current ODD availability in the AM, SM(s), or CMP, and determine growth values. The format of the command is:

OP:MEMSIZE,TORELEASE="5E???"

NOTE: It is important that the most current issue of the tool be utilized. The tool continues to go through a refinement process to improve accuracy, reflect hardware/software changes or incorporate enhancements/improvements. To identify the latest software update (BWM) loaded use the OP:VERSION command. To see the current and previous two software updates refer to page 1950 on the MCC.

10.4.2.3.1.2.3 Process

Once the command is input, the program completes the following steps.

(1) Figures the differences between the current relation dictionary file and the target relation dictionary file. If the current and the target are the same then there will be no differences.

(2) Calculates the size of its UODD, NRODD, and RODD relations. Counts the size of each relation that has a relation dictionary file difference and then modifies that total by the difference. For relations with no differences, it just uses the total of the current relation. A minimum of 256K or 30 percent free space is added to the NRODD and the RODD size and 256K or 35 percent free space is added to the UODD size. Note: Free space for the NRODD can be below 30 percent as you will see in the step 5 but the minimum amount of free space for NRODD is 256K. The total of all UODD, NRODD, and RODD relations, including the projection of how they will change in the target generic is reported in KILO ODD NEEDED column.

(3) Adds up the ODD (KILO ODD NEEDED), Text, and Peripherals Images sizes, as well as the minimum SABM. Consider this the Projected size.

(4) Reads GLPMEMSIZE to determine how much memory is in each processor. This is reported as MEG MEM EQUIPPED.

(5) Compares the amount of memory equipped (MEG MEM EQUIPPED) to the Projected (Projected) size the tool has calculated and the Engineering (Engineered) size that it gets from the spec5E file MIN MEMORY row. This is done to decide if the OP:MEMSIZE output should report a YES or a NO in the MEMORY NEEDED column. If the MEG MEM EQUIPPED is: Greater or equal to both the Projected and Engineered size Less than the Engineered size than the MEMORY NEEDED column will report YES.

Less than Projected but greater than the Engineered, the tool will decrease the amount free space in the NRODD (% FREE column) to a 256 KB minimum before it reports that there is a memory problem. This is an attempt to get the projected image to fit in the equipped memory. It will not, however, go below the Engineered size.

The greater of Projected and Engineered will be reported in the MEG TOTAL NEEDED (MIN) column.

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The % FREE column will be blank if there the MEMORY NEEDED column is YES. The % FREE column will be 30 or less depending if the Projected NRODD size was decreased as described above.

NOTE: When NRODD free space falls below 20 percent or 5 percent, minor or major alarms are activated. The free space calculated by OP:MEMSIZE will automatically set the value for free space for the retrofit. If you wish to override the % free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form. He/she must make the physical change. Remember that all NRODD free space is backup on disk. If you assign 40 percent versus 30 percent free space, you will be backing up a lot more data on disk.

When determining the amount of text memory (base text + Peripheral Options) for each SM in 5E9(2) and later, the list of specific peripherals equipped for each SM is required. When up on 5E9(2) and later, the SMMAP command, can be used to list specific peripherals for each SM.

The STP:MEMSIZE command may be executed to stop the invocation of the tool.

10.4.2.3.1.2.4 Output

To report a forecast summary of the memory needed by the office's AM, CMP, and SMs to retrofit to the specified release. The report contains the current memory sizes of all the processors and sizes needed for the target release. Output is sent to the ROP and saved in the /rclog/sodd/ memsize.rep file. The tool will verify if the current and target release data files are available. If not, it will output an error message. The tool will also verify if the hardware on the switch is ready for the retrofit. If not, it will output an error message. Any errors encountered during the execution of the tool on any processor will result in an error message reporting the processors that could not be sized.

The OP:MEMSIZE command will also output the equipment specifics (memory boards & number) for each processor in the office.

10.4.2.3.2 Switch Resource Engineering (SRE) Growable Relations

Another way of keeping memory sizes under control is SRE. A subset of the relations is sized according to individual algorithms, but can be grown (to a larger size) by using recent change view 8.40. The algorithms are designed to accommodate five standard deviations or 99.97 percent of the SMs. A small group of relations require usage data from traffic engineers. Currently, the two relations that require user input are the OSPS relations COINOT and SRVOT. They request the percent of office traffic for coin, MECH, Listing Services, and QUANTUM calls. Refer to recent change view 8.9 for more information.

The need to grow relations is rare, but may be warranted for the following situations:

- If a service requires an unusual number of tuples for call processing such as call transfer tuples for some AIN services or Automatic Call Distribution (ACD). To prevent SM breakage on a relation, the relation may be grown.

- An office is an extreme outlayer in feature usage such as very large ISDN SMs with greater than five calls per hour and greater than 210 second holding times.

- If a relation needs to be grown, contact Lucent Technologies for assistance. Please keep in mind that the number of affected offices is very small.

Relations are grown using the Translation Guide Form 5547 found in Division 3, Section 5AW Contact Lucent Technologies for assistance in determining the correct size if these relations need to be grown. The following table presents the relation acronym (Relation), relation name (Name), specific application(s) (Applic.), and a functional description (Description). The description will also point out if the RC/V name on view 8.40 is different from the relation acronym (RC/V:) and where "usage" plays a role in resource consumption (i.e. high use features). Additional SRE information (currently being modified) may be found

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in the following document:

- *Recent Change Procedures* 235-118-251 Section 10.34

WARNING: The following relations are grown using the Translation Guide Form 5547 found in Division 3, Section 5AW. Contact Lucent Technologies for assistance in determining the correct size if these relations need to be grown.

Table 10.4-4 Switch Resource Engineering Growable Relations

SWITCH RESOURCE ENGINEERING (SRE) GROWABLE RELATIONS			
RELATION	**NAME**	**APPLIC.**	**DESCRIPTION**
ACRECORD	Auxiliary Call RECORD	OSPS	RC/V: ACRD. Stores information used for billing of an OSPS call
ADB	Analog Data Block	ISDN	Stores data for the Shared DN analog member of an ISDN Shared DN group
APB	Associated Process Block	OSP	Stores FEX (future) model information for OSPS calls
APBUF	Application Processor BUFfer	AP, MSS, EDS	Buffer for messages between AM and SMP
APDU	Application Processor Data Unit	TR-303 ISDN	Stores information for Automatic Terminal Setup & TR-303 EOC maintenance messages between RT & *5ESS*® Switch
ASPBASE	Advanced Services Platform BASE	AIN, ASP	Stores info about AIN/ASP transactions.-Usage depends on dialed DN (800 call) & other AIN/ASP trigger rates (LNP) -Number of tuples for NSDB, NS_BILL & NS_IDX are derived from ASPBASE.
ASPTP	Advanced Services Platform Terminal Process	AINASP	
ATCALL	AuTo CALL	MS, EDSStores data for MSS/EDS auto call	
BRCSDB	BRCS Data Block	ISDN	Stores ISDN call feature data - Usage depends on Shared DN & ACD position call rates
CBDB	Call Buildup Data Block	BRCS, ISDN	Stores FEX (feature) data on process stack
CCSSTPDB	CCS SeTup Data Block	SS7	Stores CCS trunk signaling data
CFLNTRM	Call Forwarding LiNe TeRMination	BRCS, CF	RC/V: CFLINT. Stores Call forwarding & another feature data for CF Don't Answer calls
CFSCOP	Call Forwarding System CampOn Process	BRCS, CF	Stores call forwarding, call record & other feature data
CINDX7	SS7 INDeX	SS7	Used for efficient managing ENTRY7 tuples used for SS7 ISUP maintenance messages.
CLDB	Call Leg Data Block	BRCS, ISDN	Stores FEX (feature) model information -Usage depends on Shared DN, line time slot bridging, PRI & ACD position call rates.
COINOT	Coin Originating Treatment	OSPS	Stores data for originating OSPS coin & other call types-Usage depends on coin & MECH call rate.
CPLR	CouPLeR, PRI	ANNMNTS	Used when a many-to-one relation exists between ports & processes such as many customers listening to one announcement or one wide-band call using many trunks/PRIs.
CQB	Circuit Queuing Block	All	Stores information when queuing for a circuit that is already being used.
CRECORD	Call RECORD	Billing	RC/V: CRD. Stores billing information during call Usage depends on call forwarding call rate
CV_STATE	Call Vectoring STATE	OSPS, ACD	RC/V: CVSTATE. Stores data for OSPS ACD call vectoring-Usage depends on time in queue, percent of calls which -terminate to an ACD -first terminate to an Intelligent

			Peripheral and then transfers the call to an ACD.
DALB	D-channel Application Linkage Block	ISDN	Identifies D-channel message with calls - Usage depends on Shared DN, PRI & ACD position call rates.
DBCND	Data Block Calling Number Delivery	ICLID	Stores last incoming calling DN used by ICLID calling number delivery
DISPDB	DISPlay Data Block	ISDN	Stores display information for CPE - Usage depends on Shared DN & ACD call rates.
E911DB	E911 Data Block	E911	Stores data about E911 calls
ENTRY7	ENTRY SS7	SS7	Tracks SS7 ISUP maintenance (blocking, unblocking & reset) messages.
GPFTIME	General Purpose Functional TIMEr	ISDN	Stores data about timers associated with PRI & BRI/DSL maintenance
ISUDB			
LSCMDB	Large Shared Call Model Data Block	ISDN Shared DN	Stores information about Shared DN group for the Shared DN controlling terminal process
MALLOC	Memory ALLOCation	TR-303 ISDN	Stores information for Automatic Terminal Setup & TR-303 EOC maintenance messages between RT & *5ESS*® Switch used for ASN.1 message en(de)coding
MDB	Model Data Block	BRCS, ISDN	Stores FEX (feature) model Block ISDN information - usage depends on Shared DN, line timeslot bridging, PRI & ACD position call rates
MSMWIDA	Message Service Message Waiting Indicator DAta	MSS	Stores call information associated with a MWI activate or deactivate request for inter-switch voice messaging (ISVM)
NSDB	Network Service Data Block	AIN, ASP	RC/V: ASPBASE. Stores routing & billing information for SCP initiated routes (AIN/ASP calls)- number of tuples derived from ASPBASE
NS_BILL	Number Service BILLing	AIN, ASP	RC/V: ASPBASE. Stores bill|ng & other information about AIN/ASP trigger part of call - number of tuples derived from ASPBASE
NS_IDX	Number Service InDeX	AIN, ASP	C/V: ASPBASE. Stores data for AIN/ASP calls-number of tuples derived from ASPBAS
OAOTDB	Operator Services Originating Treatment Data Block	OSPS	Stores originating treatment feature information for OSPS T&A calls
OSPCB	Operating System Process Control Block	All	Stores data about operating system processes - Usage depends on call transfer, EDS, ISDN, display, Shared DN, On Demand B-channel & Busy Line/No Answer call rates
OSTCB	Operating System Timer Control Block	All	Stores data about operating system timers-Usage depends on ACD, OSPS, On Demand, B-channel & Busy Line/No Answer call rates
PHDB	PatH Data Block	All	Stores data on SM time slot path
PHISTORY	Port HISTORY	MAINT	Stores information on out-of-service ports OOS for more than one reason
PTRDB	PoinTeRs to Data Blocks	OSPS	Stores pointers to other OSPS data blocks
PU_ENTRY	Pick Up ENTRY	Call Pickup	RC/V: PUENTRY. Stores information on call pickup queued call
QRYDB	QueRY Data Block	OSPS	Stores data saved across transition strings for the FEX (feature) QUERY mode used when querying the SCP during OSPS calls.
QV_STATE	Queuing & Vectoring STATE	ACD BRCS	RC/V: QVSTATE. Stores data for ACD BRCS call vectoring & ACD BRCS standard queuing - Usage depends on time in queue, percent of calls which: - terminate to an ACD - first terminate to an Intelligent Peripheral, and then transfers the call to an ACD.
RTLB	Remote Terminal Linkage Block	TR303 ISDN	Stores information for Terminal ISDN Automatic Terminal Setup & TR-303 EOC maintenance Block messages between RT & *5ESS*® Switch.
RTMSGBUF	Remote Terminal	TR-303 ISDN	See RTLB

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	MeSsaGe BUFfer		
SCMDB	Shared Call Model Data Block	ISDN Shared DN	Stores information about Shared DN group for the Shared DN controlling terminal process
SDAP_SDL	Speed Dial Auto Provisioning Speed Dial List	OSPS	RC/C: SDAP. Stores data when updating the speed dial list used for OSPS AT&T calling card calls
SRVOT	SeRVices for Originating Treatment	OSPS	Stores data for listing services calls for originating treatment and EIS interface - Usage depends on listing service call rates
TATDB	Terminating Attempt Trigger Data Block	AIN ASP	Stores data about AIN/ASP calls which hit a termination trigger
TN_INFO	Termination Notification	AIN ASP	Stores data about an AIN/ASP SCP query

10.4.2.3.3 Memory Worksheets, 5E14

The following worksheet can be used to project 5E14 SM memory sizes from 5E13 SM memory sizes using output from the OP ODD report. For line 1b, feel free to use any growth factor that you deem appropriate. The worksheet defaults to 10 percent.

Note that OSPS offices may wish to add memory to RODD if they will be installing some of the OSPS special features that reside in RODD.

Worksheet SM Identifier_____

RODD

1. 5E13 NRODD

a. OP:ODD, NRODD used value = _____ KB

b. Multiply line 1a by 1.1 for 5E13 EOP growth = _____ KB

c. Calculate projected 30 percent free space = _____ KB

(3 * line 1b) / 7

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = _____ KB

UODD

2. 5E13 UODD

a. OP:ODD UODD used value = _____ KB

b. Calculate projected 30 percent free space = _____ KB

(3 * line 2a) / 7

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If line 2a < 100 KB, change to 100 KB.

c. Total UODD (line 2a + line 2b) = _____ KB

RODD

3. 5E13 RODD

a. From OP:ODD, RODD used value = _____ KB

b. Calculate projected 30 percent
free space = _____ KB

(3 * line 3b) / 7

If line 3a < 256 KB, change to 256 KB.

c. Total RODD (line 3b + line 3b) = _____ KB

4. Total ODD in MB _____ MB

Use (1d + 2c + line 3c) / 1024

5. Total 5E14 Text _____ MB

Complete Appendix A and place total here.

6. Subtotal for SM memory
(ODD + text + SAB) required = _____ MB

Line 4 + Line 5 + for SAB .05 if SM or .73 if SM-2000
and for RTBM : .008 if SM or .29 if SM-2000)

)

Line 7 to be added only if additional SAB is required:

7. Additional SAB required
(see SAB below) = _____ MB

8. Total SM memory required (with SAB) = _____ MB

(line 6 + line 7)

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Note: / = divide, * = multiply. Roundup to nearest 100th.
If line 6 is slightly over a board boundary, recalculate NRODD and UODD using 29 percent free (2.9 * line) /7.1. If the total still does not fit, recalculate using 1 percent decrements until there is a fit. If you are not satisfied with the final percent free space, order additional memory. Be aware that NRODD free space < 20 percent will trigger a minor alarm.

Appendix A

1. Base 5E14 Text

a. Input one of the following: _____ MB

(basic is 28.07, standard is 30.88, loaded is 41.88, signaling is 44.70, SM-2000 is 54.07)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92. _____ KB

If LDSF2 present, enter 660. _____ KB

If RAF present, enter 80. _____ KB

If ISTF present, enter 60. _____ KB

If LDSU or RAF or ISTF present, enter 42. _____ KB

If SAS present, enter 426. _____ KB

If GDSF present, enter 366. _____ KB

c. Add if Standard or Loaded SM,

If IDCU present, enter 742. _____ KB

d. Add if Loaded SM,

If ISLU present, enter 474. _____ KB

If PI present, enter 218. _____ KB

If PH2 present, enter 1472. _____ KB

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If PH3 present, enter 1228. _____ KB

If ISLU2 present, enter 840. _____ KB

If PI2 present, enter 450. _____ KB

If PH4 present, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718.
(Wireless only) _____ KB

If PHV4C present, enter 1232.
(Wireless only) _____ KB

e. Add if Signaling SM,

If SS7 on PSU present, enter 3992. _____ KB

If SM, complete steps f, g and h.
If SM-2000 skip to item i.

f. Calculate total peripheral images
in KB. _____ KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total
in MB = _____ MB

h. Total text (line a + line g) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

i. If SM-2000,

If LDSF, enter 202. _____ KB

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If GDSF, enter 366. _____ KB

If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 840. _____ KB

If PI2, enter 450. _____ KB

If PH4, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718.
(Wireless only) _____ KB

If PHV4C present, enter 1232.
(Wireless only) _____ KB

If SS7 on PSU, enter 3992. _____ KB

j. Calculate total peripheral images
in KB. _____ KB

(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

l. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

The worksheet will project the amount of memory that you will need for the 5E14 software release. It will be up to you to determine the difference between how much memory you currently have available, based on number and type of memory boards, and how much you will need to provide per the worksheet total. You may use the OP MEMSIZE command to obtain the types and quantity of memory boards for all SMs in the

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office.

If the difference between the amount required and the amount available is less than .3 MB for SMs, you may want to order more memory because you may be cutting your memory requirements too close or you may want to adjust your NRODD and UODD free space (See following paragraphs). The .3 MB is a guideline. You may want to increase the number since this is an estimator. For example, if 28 MB is available and the worksheet estimates 27.75 MB needed, it is recommended that you order another memory board. Remember, this worksheet is an estimator. Projecting end-of-period growth is not an exact science.

Note that the OP MEMSIZE tool will be run before the retrofit. If 30 percent free space for NRODD or UODD will require an additional memory board, the tool will decrease the percent free space for both NRODD and UODD in one percent increments until the memory fits without growing a memory board. If you are not comfortable with the percent free space that OP MEMSIZE calculates, you will need to add more memory and override the free space calculation by requesting the desired amount on the EQIM form (record 5700-1/2).

10.4.2.3.4 Non-Redundant Office-Dependent Data (NRODD) Growth-Line 1b

The 10 percent growth is for lines and features. If you expect a lot of growth or negligible growth, the percent can be adjusted accordingly.

10.4.2.3.5 NRODD Free Space-Line 1c

For retrofits, the free space will automatically be adjusted below the 30 percent default if 30 percent would require another memory board. The minimum required for a retrofit is 256 KB (.25 MB). 512 KB (.5 MB) free space (line 1c) should be more than sufficient for a maximum for SMs. SM-2000s would require a larger number. The total NRODD, line 1d, represents the total of NRODD in KB of used + available (free).

If you wish to change the percent free space in this worksheet, you will need to recalculate line 1c. For 25 percent, change line 1c to: (2.5 * line 1b) / 7.5. For 40 percent, change line 1c to: (4 * line 1b) / 6.

If you wish to override the percent free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Technologies Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form 5700-1/2 that is described in the TG-5, Division 8, Section 2, Paragraph 2.18. The Regional Engineer must make the physical change. Remember that all NRODD free space is backup on disk. If you assign 40 percent versus 30 percent free space, you will be backing up a lot more data on disk. Unprotected Office Dependent Data (UODD) growth: UODD is no longer a fixed size per the software configuration ordered. It is variable based upon the specific relations in non-redundant and redundant ODD. The minimum value for retrofits is 100 KB.

10.4.2.3.6 UODD Free Space-Line 2b

For retrofits, the free space will automatically be adjusted below the 30 percent default if 30 percent would require another memory board. Refer to NRODD free space for information on recalculating the free space and overriding the OP MEMSIZE calculation. Remember that OP MEMSIZE will use the same free space value for NRODD and UODD. The minimum value for retrofits is 100 KB. UODD free space is not backed up in disk because the data is transient.

10.4.2.3.7 Redundant Office Dependent Data (RODD) Growth

RODD consists of routing information, e.g. office screening and routing tables. Unless there is grow such as an NPA (Numbering Plan Area) split, RODD remains relatively constant. Therefore, a line for grow was not added. OSPS offices, however, may wish to add memory to RODD if they will be installing some of the OSPS special features that reside in RODD.

10.4.2.3.8 RODD Free Space-Line 3b

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A minimum of 256 KB (.25 MB) of free space is required. In most cases, the minimum will be the number used because the calculated value is usually less than 256 KB.

10.4.2.3.9 Total ODD-Line 4

Total ODD is the sum of NRODD + UODD + RODD.

10.4.2.3.10 Total Text-Line 5

Total text consists of base text plus peripheral options. Text for equipped peripheral options will be downloaded at the time of retrofit. Appendix A must be completed to calculate total text size. For 5E14, to determine which peripherals are in the SM, you can use the command SMMAP . If you are unsure as to which peripherals are equipped, you may elect to assume that all are equipped when calculating memory required. This assumption will always provide enough memory, but will also over-engineer in most cases. It will way over-engineer loaded SMs because of the number of possible choices.

10.4.2.3.11 Additional Stand Alone Billing (SAB)-Line 7

Additional SAB is an option for all SMs (including remote SMs, host SMs, optically remote SMs and 2-mile remote SMs in 5E5 and later. The amount of available memory for SAB is the difference between the total amount of available memory per number and type of memory boards and line 6. For example, if 32 MB is available (four 8 MB boards) and the total of line is 30.5, there is 32 - 30.5 MB or 1.5 MB available for SAB. If 2 MB is required and only 1.5 MB is available, SAB will get 1.5 MB unless additional memory boards are provided. To determine the amount of SAB memory required for storage of AMA records. The 54 KB of SAB that all SMs receive is the .05 added in Line 6. SM-2000 SMs receive is the .57 added in Line 6.

EXAMPLE

SM Memory Calculation for Basic SM

SM Identifier: SAMPLE BASIC SM 5E13 to 5E14

NRODD

1. 5E13 NRODD

a. OP:ODD, NRODD used value = 980 KB

b. Multiply line 1a by 1.1 for 5E14 EOP growth = 1078 KB

c. Calculate projected 30 percent free space = 462 KB

(3 * line 1b) / 7

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = 1540 KB

UODD

2. 5E13 UODD

a. OP:ODD UODD used value = 1421 KB

b. Calculate projected 30 percent free space = 609 KB

(3 * line 2a) / 7

If line 2a < 100 KB, change to 100 KB.

c. Total UODD (line 2a + line 2b) = 2030 KB

RODD

3. 5E13 RODD

a. From OP:ODD, RODD used value = 378 KB

b. Calculate projected 30 percent free space = 256 KB

(3 * line 3a) / 7

(If line 3a < 256 KB, change to 256 KB.)

c. Total RODD (line 3a + line 3b) = 634 KB

4. Total ODD in MB 4.12 MB

Use (1d + 2c + line 3c) / 1024

5. Total 5E14 Text 26.08 MB

Complete Appendix A and place total here.

6. Subtotal for SM memory
(ODD + text + SAB) required = 30.25 MB

(line 4 + line 5 + .05 if SM or .73 if SM-2000)
and RMB .008 if SM or .29 if SM-2000

Line 7 to be added only if additional SAB is required:

7. Additional SAB required
(see SAB below) = 0 MB

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8. Total SM memory required (with SAB) = 30.25 MB

(line 6 + line 7)

Note: / = divide, * = multiply. Roundup to nearest 100th.
If line 6 is slightly over a board boundary, recalculate NRODD and UODD using 29 percent free (2.9 * line) /7.1. If the total still does not fit, recalculate using 1 percent decrements until there is a fit. If you are not satisfied with the final percent free space, order additional memory. Be aware that NRODD free space < 20 percent will trigger a minor alarm.

Appendix A

1. Base 5E14 Text

a. Input one of the following: 24.75 MB
(basic is 28.07, std is 30.88, loaded is 41.88, signaling is 44.70, SM-2000 is 54.07)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92. 92 KB

If LDSF2 present, enter 660. 660 KB

If RAF present, enter 80. 80 KB

If ISTF present, enter 60. 60 KB

If LDSU or RAF or ISTF present, enter 42. 42 KB

If SAS present, enter 426. 426 KB

If GDSF present, enter 366. _____ KB

c. Add if Standard or Loaded SM,

If IDCU present, enter 742. _____ KB

d. Add if Loaded SM,

If ISLU present, enter 474. _____ KB

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If PI present, enter 218. _____ KB

If PH2 present, enter 1472. _____ KB

If PH3 present, enter 1156. _____ KB

If ISLU2 present, enter 840. _____ KB

If PI2 present, enter 450. _____ KB

If PH4 present, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718.
(Wireless only) _____ KB

e. Add if Signaling SM,

If SS7 on PSU present,
enter 3992. _____ KB

If SM, complete steps f, g and h.

If SM-2000 skip to item i.

f. Calculate total peripheral images
in KB. 1360KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total
in MB = 1.33 MB

h. Total text (line a + line g) = 26.08 MB

i. If SM-2000

If LDSF, enter 202. _____ KB

If GDSF, enter 366. _____ KB

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If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 840. _____ KB

If PI2, enter 450. _____ KB

If PH4, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718
(Wireless only) _____ KB

If SS7 on PSU, enter 3992. _____ KB

j. Calculate total peripheral images
in KB. _____ KB

(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

l. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

In this case, more than 35 MB is required. The minimum would be 32 MB for the closest memory board boundary. 32 MB - 30.25 MB leaves approximately 1.75 MB for SAB if additional SAB is desired and another memory board is not desired. If more than 1.75MB of additional SAB is desired, another memory board would be needed. Note that for 5E13 a Basic SM requires 36 MB to be equipped. Which means the SMP23CDM Memory Expansion feature must be initiated, a new SM ordered (MCTU3), or consolidation takes

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place via Project Renaissance to an SM-2000.

10.4.3 5E15 SOFTWARE RELEASE

10.4.3.1 HARDWARE

10.4.3.1.1 AM

10.4.3.1.1.1 3B21D AM

The AM is currently equipped with 128MB of memory via a 32 MB core board and three 32 MB Single In-Line Memory Module (SIMM), which is the same as the 5E14 software release.

10.4.3.1.2 Switching Module (SM)

Table 10.4-5 shows the 5E15 SMPU configurations.

Table 10.4-5 5E15 SMPU Configurations

PROCESSOR [a]		MEMORY BOARDS [b]	MAX. SLOTS [c]	MAX. EQUIPAGE (MB) [d]
SMP23CDMX	68020	TN1423 TN2012		52 5
SMP20 SMP20DC	68020	TN1374 TN1376 TN1661	6 6 6	24 48 96
CORE40	68040	TN1685 TN1806	4 2	128 256
CORE60	68060	TN1685 TN1806	4 2	192 256
SB20CORE	68LC040	KBN20 KBN21 KBN22	1 MM 2 MM 3 MM	 32 64 96
CORE60MM UN 588	68060	TN1685 TN1806	2 2	192 256

Notes:

a. Processor addressability limits: 68012 & 68023 - 32 MB, 68020 - 4 GB,SB20CORE/ CORE40 /CORE60 - 748 MB.

b. TN56 = 2MB, TN2012 = 4 MB, TN1374 = 4 MB, TN1376 = 8 MB, TN1661 = 16 MB, TN1685 =32 MB, TN1423=32 MB, TN1806 = 64 MB. The TN1374,TN1376,TN1661 boards may be mixed in the same MCTU2 (68020). The other boards are not mixable. The TN1423 is a new microprocessor board with dynamic memory. The TN1685 and TN1806 can be mixed in the same CORE40/60. or CORE60MM. The CORE40 has no memory on the processor board; the CORE60 has 64MB on the board, and the CORE60MM can be equipped with 64 MB or 128 MB of memory

c. Max slots for CORE60 assumes SM-2000 unit. Max slots for CORE60MM assumes SM2005 unit.

d. Maximum equipage (**) requires the use of the MEU (Memory Expansion Unit).Memory totals denote DRAM on processor pack plus all external memory packs

e. The TN1423 is a processor board which supports 32 megabytes of on-board memory; the SMP23CDM does not support external memory boards, the SMP23CDMX supports zero to five TN2012 external memory boards.

10.4.3.1.2.1 TN1423 Microprocessor Board (Feature SMP23CDM)

This feature is also known as SMP23CDM (provided in 5E10) for SMP23 Dynamic Core Memory and provided 32 MB of memory. The feature was ported back to 5E9(1) software release so that offices skipping from 5E9(1) to the 5E10 software release could use it. It was also ported to the 5E9(2) software release because it needs to be added before any retrofit to 5E10. This feature supports the conversion from the SMP12 to TN1423. Prudent use of this board can save money when growing memory. The TN1423 is priced slightly higher than the cost of an MEU and one TN2012. When this board is installed in SMs equipped with TN2012s, the five TN2012s can be used to grow memory in other SMs with MEUs or a few MEUs may be ordered to grow memory in some SMs using the surplus TN2012s. The surplus TN2012 boards can also be used to grow AM memory.

10.4.3.1.2.2 SMP23CDMX

The TN1423 in combination with the TN1408 , the TN1418 and appropriate wiring upgrade comprise the SMP23CDMX. This combination permits the TN1423 to use external memory packs.

10.4.3.1.2.3 Module Control Time Slot Interchange Unit Version 3 (MCTU3)

Non-SM-2000 SMs shipped equipped with the MCTU3 that has a 68LC040 processor (beginning with 5E10 software release update). The MCTU3 has all the existing functionality of the SMP20 plus additional capabilities. It is a one-shelf unit, instead of the two-shelf unit (MCTU2) needed for the SMP20.

10.4.3.1.3 SM-2000 Memory

As part of the 5E11 software release update, a new backplane and compressed shelving is shipped with all new offices. The compressed unit is known as the SMPU5. The CORE60 was shipped with the SM-2000 in all 5E11 orders, regardless of whether the SMPU4 or SMPU5 is equipped. The SMPU4 is equipped with four memory slots. The SMPU5 is equipped with two memory slots. The CORE60 is equipped with the first 64 MB of memory attached to the processor core board. With 128 MB required, two TN1685s can be used or one TN1806. ***Note: If two TN1685s are used in the SMPU5, both memory slots are equipped.*** Note that if an upgrade from a CORE40 to a CORE60 will be ordered for improved real time, some of the 32 MB memory packs will no longer be needed as the CORE60 comes with 64 MB on the processor board.

10.4.3.1.3.1 CORE60MM

The CORE60MM is designed to improve the processor performance and provide two CORE RAM memory configurations of either 64MB (UN594) or 128 MB (UN588). The hardware and associated software for the CORE60MM are are designed to improve the speed of the SM-2000 Switching Module by a factor of 1.8 over the CORE40. The 64MB CORE60MM (UN594) is supported on SM-2000 for software release 5E12. The 128 MB CORE60MM (UN588) is supported on SM2005 for release 5E12. The 128MB CORE60MM (UN588) will be used for all newly shipped SMPU5 offices.

10.4.3.2 SOFTWARE

10.4.3.2.1 Switching Module (SM)

With Software Release 5E15, there are five software configurations: basic, standard, loaded, signaling, and SM-2000. Signaling is a software configuration for VCDX offices equipped with an SM that support SS7 signaling on a packet switch unit (PSU). The signaling configuration has everything from the loaded configuration plus the ability to do SS7 signaling.

10.4.3.2.1.1 Peripheral Image Sizes for 5E15

Table 10.4-6 5E15 Image Sizes and Configuration Support

IMAGE	KB	BASIC	STANDARD	LOADED	SIGNAL	SM-2000
LDSU	92	□	□	□	□	

LDSF +DSC4	660	□	□	□	□	
RAF	80	□	□	□	□	
ISTF	60 + 42	□	□	□	□	
LDSU, RAF, ISTF **a**	42	□	□	□	□	
IDCU	742		□	□	□	□
GDSF	366	□	□	□	□	□
SAS	426	□	□	□	□	□
ISLU	474			□		
ISLU2	840			□	□	□
PI	218			□		
PI2	450			□	□	□
PH2	1472			□		
PH3	1156			□		
PH4	1666			□	□	□
PH22	1352			□	□	□
SS7 on PSU	3992				□	□
PHV **d**	514			□	□	□
PHA **d**	514			□	□	□
PHV3C **d**	718			□	□	□
PHV4C **a**	1162			□	□	□
LDSF **b**	202					□
GDSF or LDSF **c**	202	□	□	□	□	□
GDSF + DSC3	568	□				
SLU2	840					□
DNUS	1054					□

Notes:

a. If the SM has LDSU, RAF, or ISTF, the 42 KBs is counted only once. Although LDSU was originally segregated as an option, most SMs will require this option. The few SMs that will NOT require this option are SMs that are only equipped with the older LDSU1. The LDSU1 does not support SS7 functionality.

b. LDSF Functionality is provided with all SM-2000 SMs. Therefore, if you have SM-2000, you will need LDSF with 202 kB and the additional 202 kB if you have GDSF, or LDSF.

c. If the SM has GDSF or LDSF, the 202 kB is counted only once. This code supports the DSC3 functionality.

d. For CDMA in wireless offices only.

10.4.3.2.1.2 Variable UODD

Another change from previous releases is the sizing of unprotected office dependent data (UODD). In software releases prior to 5E9(2), UODD had a fixed size for each SM software configuration. UODD is a variable number. The size varies based upon the specific features and number of lines supported in static ODD (non-redundant and redundant). For example, in the 5E8 software release, the UODD for all Basic SMs was one fixed size of 1304 KB. Now, each SM has a unique size. The office data assembler (ODA) checks all static relations and totals the UODD required to support those static relations. There is a fixed association between the static data and the related relations stored in UODD.

10.4.3.2.2 Memory Engineering Guidelines

Some 5E15 offices may require more than the physical memory requirement per SM configurations. The variance in total office dependent data (ODD) between offices is growing exponentially due to changes in the marketplace. As customers incorporate changes such as turning offices into "virtual" switches by assigning specific hundreds groups of screening indexes to resellers, for example, the amount of redundant ODD (RODD) increases at a rate never seen before. In other words, translations for routing and screening are being used in "new" ways. As more and more routing and screening data is required with the new competitive environment, more RODD will be required. For these reasons, Lucent is looking for ways to

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better estimate memory requirements. The existing planning algorithms may need to be changed to account for the wider spread in ODD. Memory requirements for all configurations (especially Basic, Standard, and Loaded) are being investigated. New memory requirements for these configurations are provided as they become available.

The following are the memory engineering guidelines for each of the SM configurations. For each configuration, the software release text (non-ODD) requirement without any optional peripherals and with optional peripherals is given with the default ODD sizes.

Total memory required = text+NRODD+RODD+UODD+SAB+PO.

In order to determine the total amount of memory required, the OP ODD report lists the existing NRODD, RODD, UODD, and SAB. The missing part has always been the text size and now the PO sizes. Base text size is determined by the software configuration. The OP MEMSIZE report lists the software configuration for all SMs in the office. The configuration to size is a look-up function in this command.

The command DUMP:SMMAP can be used to determine the POs that are equipped.

When using the following configuration information , you may refer to Table 10.4-5 for PO sizes. The total memory includes the text, ODD, and SAB listed in the description plus the PO value in the table to determine the total memory (in MB) required.

10.4.3.2.2.1 Basic SM

The 5E15 software release text base and patch sizes for the Basic SM are 30.85 MB. The ODD size for 90 percent of the Basic SMs in 5E15 is 11.81 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, and HDSU for a total of 1.66 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, and SAS for a total of 1.66 MB. Therefore, most Basic SMs will fit in 44 MBs (actual) or less (48 MB physical). In SMs, the reserved SAB is 56KB.

10.4.3.2.2.2 Standard SM

The 5E15 software release text base and patch sizes for the Standard SM are 33.18 MB. The ODD size for 90 percent of the Standard SMs in 5E15 is 11.31 MB or less (10.27 MB or less for OSPS). The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, and IDCU for a total of 2.38 MB (1.66 MB for OSPS). The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, SAS, and IDCU for a total of 2.38 MB. Therefore, most Standard SMs will fit in 47 MB (actual) or less (52 MB physical). In SMs, reserved SAB is 56 KB.

A Standard SM will require only 52 MB. This is due to close proximity to board breakage point of 48 MB, as well as SABM required for RSMs. This is the last release a MCTU1 will support a Standard SM from a memory standpoint. All Standard SMs with MCTU1 must convert to MCTU3 or SM-2000 (best choice) prior to retrofitting to 5E16.2.

10.4.3.2.2.3 Loaded SM

The 5E15 software release text base and patch sizes for the Loaded SM are 45.80 MB. The ODD size for 90 percent of the Loaded SMs in 5E15 is 13.17 MB or less (14.44 MB or less for OSPS and 7.44 MB or less for TDMA/CDMA). The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, IDCU, ISLU, PI, PH2 and PH3 for a total of 10.34 MB (4.74 MB of OSPS with no PSU2).

The POs for CDMA retrofits are assumed to be equipped with LDSU, ISTF, HDSU, PI2, PH4, PHV, and PHA for a total of 11.34 MB.

Loaded SMs are projected to fit within 70 MB (actual) or less (72 MB physical). For OSPS and wireless, most SMs are projected to fit within 65 MB (actual) or less (68 MB physical). In SMs, reserved SAB is 56 KB.

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10.4.3.2.2.4 Signaling SM

This software configuration has been added for SM and VDCX offices that wish to support SS7 signaling on a Packet Switch Unit (PSU). VCDX offices that do not wish to support SS7 signaling can use the loaded software configuration above. SS7 signaling on PSU requires PH3 protocol handlers.

The 5E15 software release text base and patch sizes for the Signaling SM are 58.27 MB. The ODD size for 90 percent of the Signaling SM in 5E15 is 11.80MB or less (10.11 MB or less for VCDX) . The POs are assumed to equipped with LDSU, HDSU, GDSF, SAS, IDCU, ISLU2, PI2, PH3, PH4, and SS7 on PSU for a total of 13.82 MB (15.05 MB for VCDX) . The POs for a new VCDX are assumed to be a total of 13.82 MB.

Stand alone billing (SAB) memory has been added to the VCDX offices because they must provide the ability to hold at least 72 hours of billing data in stand alone mode. Since Signaling SMs will not equip all the POs, all SMs are projected to fit within 74 MB (actual) or less (76 MB physical). Wireline Signaling SMs are projected to fit within 73 MB (actual) or less (76 MB physical).

10.4.3.2.2.5 Stand Alone Billing Changes

There is a change taking place with Stand Alone Billing (SAB). This change is being made to enhance the management of memory. Actively managing SAB memory emphasizes the need to monitor memory that would store billing records for the duration of a stand alone. There is no change in that when SAB is set to "YES", all unallocated memory is dedicated to SAB. In the past, it was readily available at ODD growth time, "Auto Shrink". In the future, this memory **will not** be automatically available. SAB will need to be degrown by the amount needed or new memory added, "No Auto Shrink".

NOTE: There will also be an addition to the SM memory layout called Real Time Billing Memory (RTBM). A default amount of memory will be provided for every SM, whether or not the Long Distance Platform, Real Time Call Detail feature is utilized The default size is 8 KB for a SM and 288 KB for an SM-2000.

10.4.3.2.3 SM-2000

The 5E15 software release text base and patch sizes for SM-2000 are 58.27 MB. The ODD size for 90 percent of the SM-2000 is 64.59 MB or less (38.09 MB or less for TDMA/CDMA and 68.21 MB or less for VCDX).

The POs for service provider retrofits are assumed to be equipped with LDSF, DSC3, and DNUS for 13.54 MB. The POs for a T/CDMA retrofit are assumed to be equipped with LDSU (DSU2), LDSF+DSC4, ISTF, GDSF=DSC3, PI2, PH4, PHV1, and PHA1 for a total of 17.37 MB. The POs for VCDX retrofits are assumed to be LDSF, GDSF, DSC3, DNUS, ISLU2, PI2, PH4, SAS, IDCU, and SS7 on PSU for a total of 22.48 MB.

The SM-2000 is under 134 MB (actual) and 160 MB (physical). The VCDX SM-2000 is under 157 MB (actual) and 192 MB (physical). DNU-S is a heavy memory consumer. Wireline SM-2000s can handle approximately one and one-half fully loaded DNU-S and the VCDX SM-2000 can handle three fully loaded DNU-S. The needs of SM UODD in particular must be taken into consideration. The reserved Stand Alone Billing (SAB) in SM-2000 is 740 KB. Stand Alone Billing (SAB) memory has been added to the VCDX offices because they must provide the ability to hold at least 72 hours of billing data in stand alone mode.

10.4.3.3 ADMINISTRATION

10.4.3.3.1 Switching Module

10.4.3.3.1.1 SMMAP Command

The SMMAP command, is dump:smmap, sm=x When reading this command, the start and end address of

each image and its associated hashsum (parity check for errors) is listed. Many of the peripheral images listed in Table 10.4-6 , are the sum of several individual images that come as a "family". Each member of the family and associated hash sum check are listed in the dump of the SMMAP command.

10.4.3.3.1.2 OP MEMSIZE Command

10.4.3.3.1.2.1 Description

The OP:MEMSIZE command can be used to project memory requirements from release to release. For example, if an office is on software release 5E14 retrofitting to software release 5E15, a software update is loaded which contains the memory projections for 5E15. When the command is run (i.e. using TORELEASE "5E151"), the new memory requirements are calculated and the hardware is checked to determine if additional memory boards are required before the retrofit. The command may also be used to monitor memory grow within a release (i.e. using TO RELEASE "5E151"). The command also lists on a per SM basis, the type and quantity of all memory packs, the software configuration, and whether additional Stand Alone Billing is set to yes.

10.4.3.3.1.2.2 Input

The OP:MEMSIZE input command is used to list current ODD availability in the AM, SM(s), or CMP, and determine growth values. The format of the command is:

OP:MEMSIZE,TORELEASE="5E???"

NOTE: It is important that the most current issue of the tool be utilized. The tool continues to go through a refinement process to improve accuracy, reflect hardware/software changes or incorporate enhancements/improvements. To identify the latest software update (BWM) loaded use the OP:VERSION command. To see the current and previous two software updates refer to page 1950 on the MCC.

10.4.3.3.1.2.3 Process

Once the command is input, the program completes the following steps.

(1) Figures the differences between the current relation dictionary file and the target relation dictionary file. If the current and the target are the same then there will be no differences.

(2) Calculates the size of its UODD, NRODD, and RODD relations. Counts the size of each relation that has a relation dictionary file difference and then modifies that total by the difference. For relations with no differences, it just uses the total of the current relation. A minimum of 256K or 30 percent free space is added to the NRODD and the RODD size and 256K or 35 percent free space is added to the UODD size. Note: Free space for the NRODD can be below 30 percent as you will see in the step 5 but the minimum amount of free space for NRODD is 256K. The total of all UODD, NRODD, and RODD relations, including the projection of how they will change in the target generic is reported in KILO ODD NEEDED column.

(3) Adds up the ODD (KILO ODD NEEDED), Text, and Peripherals Images sizes, as well as the minimum SABM. Consider this the Projected size.

(4) Reads GLPMEMSIZE to determine how much memory is in each processor. This is reported as MEG MEM EQUIPPED.

(5) Compares the amount of memory equipped (MEG MEM EQUIPPED) to the Projected (Projected) size the tool has calculated and the Engineering (Engineered) size that it gets from the spec5E file MIN MEMORY row. This is done to decide if the OP:MEMSIZE output should report a YES or a NO in the MEMORY NEEDED column. If the MEG MEM EQUIPPED is: Greater or equal to both the

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Projected and Engineered size Less than the Engineered size than the MEMORY NEEDED column will report YES.

Less than Projected but greater than the Engineered, the tool will decrease the amount free space in the NRODD (% FREE column) to a 256 K minimum before it reports that there is a memory problem. This is an attempt to get the projected image to fit in the equipped memory. It will not, however, go below the Engineered size.

The greater of Projected and Engineered will be reported in the MEG TOTAL NEEDED (MIN) column.

The % FREE column will be blank if there the MEMORY NEEDED column is YES. The % FREE column will be 30 or less depending if the Projected NRODD size was decreased as described above.

NOTE: When NRODD free space falls below 20 percent or 5 percent, minor or major alarms are activated. The free space calculated by OP:MEMSIZE will automatically set the value for free space for the retrofit. If you wish to override the percent free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form. He/she must make the physical change. Remember that all NRODD free space is backup on disk. If you assign 40 percent versus 30 percent free space, you will be backing up a lot more data on disk.

When determining the amount of text memory (base text + Peripheral Options) for each SM in 5E9(2) and later, the list of specific peripherals equipped for each SM is required. When up on 5E9(2) and later, the SMMAP command, can be used to list specific peripherals for each SM.

The STP:MEMSIZE command may be executed to stop the invocation of the tool.

10.4.3.3.1.2.4 Output

To report a forecast summary of the memory needed by the office's AM, CMP, and SMs to retrofit to the specified release. The report contains the current memory sizes of all the processors and sizes needed for the target release. Output is sent to the ROP and saved in the /rclog/sodd/ memsize.rep file. The tool will verify if the current and target release data files are available. If not, it will output an error message. The tool will also verify if the hardware on the switch is ready for the retrofit. If not, it will output an error message. Any errors encountered during the execution of the tool on any processor will result in an error message reporting the processors that could not be sized.

The OP:MEMSIZE command will also output the equipment specifics (memory boards & number) for each processor in the office.

10.4.3.3.2 Switch Resource Engineering (SRE) Growable Relations

Another way of keeping memory sizes under control is SRE. A subset of the relations is sized according to individual algorithms, but can be grown (to a larger size) by using recent change view 8.40. The algorithms are designed to accommodate five standard deviations or 99.97 percent of the SMs. A small group of relations require usage data from traffic engineers. Currently, the two relations that require user input are the OSPS relations COINOT and SRVOT. They request the percent of office traffic for coin, MECH, Listing Services, and QUANTUM calls. Refer to recent change view 8.9 for more information.

The need to grow relations is rare, but may be warranted for the following situations:

- If a service requires an unusual number of tuples for call processing such as call transfer tuples for some AIN services or Automatic Call Distribution (ACD). To prevent SM breakage on a relation, the relation may be grown.

- An office is an extreme outlayer in feature usage such as very large ISDN SMs with greater than five calls per hour and greater than 210 second holding times.

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- If a relation needs to be grown, contact Lucent Technologies for assistance. Please keep in mind that the number of affected offices is very small.

Relations are grown using the Translation Guide Form 5547 found in Division 3, Section 5AW Contact Lucent Technologies for assistance in determining the correct size if these relations need to be grown. The following table presents the relation acronym (Relation), relation name (Name), specific application(s) (Applic.), and a functional description (Description). The description will also point out if the RC/V name on view 8.40 is different from the relation acronym (RC/V:) and where "usage" plays a role in resource consumption (i.e. high use features). Additional SRE information (currently being modified) may be found in the following document:

- *Recent Change Procedures* 235-118-251 Section 10.34

WARNING: The following relations are grown using the Translation Guide Form 5547 found in Division 3, Section 5AW. Contact Lucent Technologies for assistance in determining the correct size if these relations need to be grown.

Table 10.4-7 5E15 Switch Resource Engineering Growable Relations

SWITCH RESOURCE ENGINEERING (SRE) GROWABLE RELATIONS			
RELATION	**NAME**	**APPLIC.**	**DESCRIPTION**
ACRECORD	Auxiliary Call RECORD	OSPS	RC/V: ACRD. Stores information used for billing of an OSPS call
ADB	Analog Data Block	ISDN	Stores data for the Shared DN analog member of an ISDN Shared DN group
APB	Associated Process Block	OSP	Stores FEX (future) model information for OSPS calls
APBUF	Application Processor BUFfer	AP, MSS, EDS	Buffer for messages between AM and SMP
APDU	Application Processor Data Unit	TR-303 ISDN	Stores information for Automatic Terminal Setup & TR-303 EOC maintenance messages between RT & *5ESS*® Switch
ASPBASE	Advanced Services Platform BASE	AIN, ASP	Stores info about AIN/ASP transactions.-Usage depends on dialed DN (800 call) & other AIN/ASP trigger rates (LNP) -Number of tuples for NSDB, NS_BILL & NS_IDX are derived from ASPBASE.
ASPTP	Advanced Services Platform Terminal Process	AINASP	
ATCALL	AuTo CALL	MS, EDSStores data for MSS/EDS auto call	
BRCSDB	BRCS Data Block	ISDN	Stores ISDN call feature data - Usage depends on Shared DN & ACD position call rates
CBDB	Call Buildup Data Block	BRCS, ISDN	Stores FEX (feature) data on process stack
CCSSTPDB	CCS SeTup Data Block	SS7	Stores CCS trunk signaling data
CFLNTRM	Call Forwarding LiNe TeRMination	BRCS, CF	RC/V: CFLINT. Stores Call forwarding & another feature data for CF Don't Answer calls
CFSCOP	Call Forwarding System CampOn Process	BRCS, CF	Stores call forwarding, call record & other feature data
CINDX7	SS7 INDeX	SS7	Used for efficient managing ENTRY7 tuples used for SS7 ISUP maintenance messages.
CLDB	Call Leg Data Block	BRCS, ISDN	Stores FEX (feature) model information -Usage depends on Shared DN, line time slot bridging, PRI & ACD position call rates.
COINOT	Coin Originating	OSPS	Stores data for originating OSPS coin & other call types-Usage

	Treatment		depends on coin & MECH call rate.
CPLR	CouPLeR, PRI	ANNMNTS	Used when a many-to-one relation exists between ports & processes such as many customers listening to one announcement or one wide-band call using many trunks/PRIs.
CQB	Circuit Queuing Block	All	Stores information when queuing for a circuit that is already being used.
CRECORD	Call RECORD	Billing	RC/V: CRD. Stores billing information during call Usage depends on call forwarding call rate
CV_STATE	Call Vectoring STATE	OSPS, ACD	RC/V: CVSTATE. Stores data for OSPS ACD call vectoring-Usage depends on time in queue, percent of calls which -terminate to an ACD -first terminate to an Intelligent Peripheral and then transfers the call to an ACD.
DALB	D-channel Application Linkage Block	ISDN	Identifies D-channel message with calls - Usage depends on Shared DN, PRI & ACD position call rates.
DBCND	Data Block Calling Number Delivery	ICLID	Stores last incoming calling DN used by ICLID calling number delivery
DISPDB	DISPlay Data Block	ISDN	Stores display information for CPE - Usage depends on Shared DN & ACD call rates.
E911DB	E911 Data Block	E911	Stores data about E911 calls
ENTRY7	ENTRY SS7	SS7	Tracks SS7 ISUP maintenance (blocking, unblocking & reset) messages.
GPFTIME	General Purpose Functional TIMEr	ISDN	Stores data about timers associated with PRI & BRI/DSL maintenance
ISUDB			
LSCMDB	Large Shared Call Model Data Block	ISDN Shared DN	Stores information about Shared DN group for the Shared DN controlling terminal process
MALLOC	Memory ALLOCation	TR-303 ISDN	Stores information for Automatic Terminal Setup & TR-303 EOC maintenance messages between RT & *5ESS*® Switch used for ASN.1 message en(de)coding
MDB	Model Data Block	BRCS, ISDN	Stores FEX (feature) model Block ISDN information - usage depends on Shared DN, line timeslot bridging, PRI & ACD position call rates
MSMWIDA	Message Service Message Waiting Indicator DAta	MSS	Stores call information associated with a MWI activate or deactivate request for inter-switch voice messaging (ISVM)
NSDB	Network Service Data Block	AIN, ASP	RC/V: ASPBASE. Stores routing & billing information for SCP initiated routes (AIN/ASP calls)- number of tuples derived from ASPBASE
NS_BILL	Number Service BILLing	AIN, ASP	RC/V: ASPBASE. Stores bill|ng & other information about AIN/ASP trigger part of call - number of tuples derived from ASPBASE
NS_IDX	Number Service InDeX	AIN, ASP	C/V: ASPBASE. Stores data for AIN/ASP calls-number of tuples derived from ASPBAS
OAOTDB	Operator Services Originating Treatment Data Block	OSPS	Stores originating treatment feature information for OSPS T&A calls
OSPCB	Operating System Process Control Block	All	Stores data about operating system processes - Usage depends on call transfer, EDS, ISDN, display, Shared DN, On Demand B-channel & Busy Line/No Answer call rates
OSTCB	Operating System Timer Control Block	All	Stores data about operating system timers-Usage depends on ACD, OSPS, On Demand, B-channel & Busy Line/No Answer call rates
PHDB	PatH Data Block	All	Stores data on SM time slot path
PHISTORY	Port HISTORY	MAINT	Stores information on out-of-service ports OOS for more than one reason
PTRDB	PoinTeRs to Data Blocks	OSPS	Stores pointers to other OSPS data blocks
PU_ENTRY	Pick Up ENTRY	Call Pickup	RC/V: PUENTRY. Stores information on call pickup queued call
QRYDB	QueRY Data Block	OSPS	Stores data saved across transition strings for the FEX

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			(feature) QUERY mode used when querying the SCP during OSPS calls.
QV_STATE	Queuing & Vectoring STATE	ACD BRCS	RC/V: QVSTATE. Stores data for ACD BRCS call vectoring & ACD BRCS standard queuing - Usage depends on time in queue, percent of calls which: - terminate to an ACD - first terminate to an Intelligent Peripheral, and then transfers the call to an ACD.
RTLB	Remote Terminal Linkage Block	TR303 ISDN	Stores information for Terminal ISDN Automatic Terminal Setup & TR-303 EOC maintenance Block messages between RT & *5ESS*® Switch.
RTMSGBUF	Remote Terminal MeSsaGe BUFfer	TR-303 ISDN	See RTLB
SCMDB	Shared Call Model Data Block	ISDN Shared DN	Stores information about Shared DN group for the Shared DN controlling terminal process
SDAP_SDL	Speed Dial Auto Provisioning Speed Dial List	OSPS	RC/C: SDAP. Stores data when updating the speed dial list used for OSPS AT&T calling card calls
SRVOT	SeRVices for Originating Treatment	OSPS	Stores data for listing services calls for originating treatment and EIS interface - Usage depends on listing service call rates
TATDB	Terminating Attempt Trigger Data Block	AIN ASP	Stores data about AIN/ASP calls which hit a termination trigger
TN_INFO	Termination Notification	AIN ASP	Stores data about an AIN/ASP SCP query

10.4.3.3.3 Memory Worksheets, 5E15

The following worksheet can be used to project 5E15 SM memory sizes from 5E14 SM memory sizes using output from the OP ODD report. For line 1b, feel free to use any growth factor that you deem appropriate. The worksheet defaults to 10 percent.

Note that OSPS offices may wish to add memory to RODD if they will be installing some of the OSPS special features that reside in RODD.

Worksheet SM Identifier_____

RODD

1. 5E14 NRODD

a. OP:ODD, NRODD used value = _____ KB

b. Multiply line 1a by 1.1 for 5E14 EOP growth = _____ KB

c. Calculate projected 30 percent free space = _____ KB

(3 * line 1b) / 7

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = _____ KB

UODD

2. 5E14 UODD

a. OP:ODD UODD used value = _____ KB

b. Calculate projected 30 percent
free space = _____ KB

(3 * line 2a) / 7

If line 2a < 100 KB, change to 100 KB.

c. Total UODD (line 2a + line 2b) = _____ KB

RODD

3. 5E14 RODD

a. From OP:ODD, RODD used value = _____ KB

b. Calculate projected 30 percent
free space = _____ KB

(3 * line 3b) / 7

If line 3a < 256 KB, change to 256 KB.

c. Total RODD (line 3b + line 3b) = _____ KB

4. Total ODD in MB _____ MB

Use (1d + 2c + line 3c) / 1024

5. Total 5E15 Text _____ MB

Complete Appendix A and place total here.

6. Subtotal for SM memory
(ODD + text + SAB) required = _____ MB

Line 4 + Line 5 + for SAB .05 if SM or .73 if SM-2000
and for RTBM : .008 if SM or .29 if SM-2000)

)

Line 7 to be added only if additional SAB is required:

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7. Additional SAB required
(see SAB below) = _____ MB

8. Total SM memory required (with SAB) = _____ MB

(line 6 + line 7)

Note: / = divide, * = multiply. Roundup to nearest 100th.
If line 6 is slightly over a board boundary, recalculate NRODD and UODD using 29 percent free (2.9 * line) /7.1. If the total still does not fit, recalculate using 1 percent decrements until there is a fit. If you are not satisfied with the final percent free space, order additional memory. Be aware that NRODD free space < 20 percent will trigger a minor alarm.

Appendix A

1. Base 5E15 Text

a. Input one of the following: _____ MB

(basic is 30.85, standard is 33.18, loaded is 45.80, signaling is 46.54, SM-2000 is 58.27)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92. _____ KB

If LDSF2 present, enter 660. _____ KB

If RAF present, enter 80. _____ KB

If ISTF present, enter 60. _____ KB

If LDSU or RAF or ISTF present, enter 42. _____ KB

If SAS present, enter 426. _____ KB

If GDSF present, enter 366. _____ KB

c. Add if Standard or Loaded SM,

If IDCU present, enter 742. _____ KB

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d. Add if Loaded SM,

If ISLU present, enter 474. _____ KB

If PI present, enter 218. _____ KB

If PH2 present, enter 1472. _____ KB

If PH3 present, enter 1228. _____ KB

If ISLU2 present, enter 840. _____ KB

If PI2 present, enter 450. _____ KB

If PH4 present, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718.
(Wireless only) _____ KB

If PHV4C present, enter 1232.
(Wireless only) _____ KB

e. Add if Signaling SM,

If SS7 on PSU present, enter 3992. _____ KB

If SM, complete steps f, g and h.
If SM-2000 skip to item i.

f. Calculate total peripheral images
in KB. _____ KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total
in MB = _____ MB

h. Total text (line a + line g) = _____ MB

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ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

i. If SM-2000,

If LDSF, enter 202. _____ KB

If GDSF, enter 366. _____ KB

If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 840. _____ KB

If PI2, enter 450. _____ KB

If PH4, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718.
(Wireless only) _____ KB

If PHV4C present, enter 1232.
(Wireless only) _____ KB

If SS7 on PSU, enter 3992. _____ KB

j. Calculate total peripheral images
in KB. _____ KB

(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

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l. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

The worksheet will project the amount of memory that you will need for the 5E15 software release. It will be up to you to determine the difference between how much memory you currently have available, based on number and type of memory boards, and how much you will need to provide per the worksheet total. You may use the OP MEMSIZE command to obtain the types and quantity of memory boards for all SMs in the office.

If the difference between the amount required and the amount available is less than .3 MB for SMs, you may want to order more memory because you may be cutting your memory requirements too close or you may want to adjust your NRODD and UODD free space (See following paragraphs.). The .3 MB is a guideline. You may want to increase the number since this is an estimator. For example, if 28 MB is available and the worksheet estimates 27.75 MB needed, it is recommended that you order another memory board. Remember, this worksheet is an estimator. Projecting end-of-period growth is not an exact science.

Note that the OP MEMSIZE tool will be run before the retrofit. If 30 percent free space for NRODD or UODD will require an additional memory board, the tool will decrease the percent free space for both NRODD and UODD in one percent increments until the memory fits without growing a memory board. If you are not comfortable with the percent free space that OP MEMSIZE calculates, you will need to add more memory and override the free space calculation by requesting the desired amount on the EQIM form (record 5700-1/2).

10.4.3.3.4 Non-Redundant Office-Dependent Data (NRODD) Growth-Line 1b

The 10 percent growth is for lines and features. If you expect a lot of growth or negligible growth, the percent can be adjusted accordingly.

10.4.3.3.5 NRODD Free Space-Line 1c

For retrofits, the free space will automatically be adjusted below the 30 percent default if 30 percent would require another memory board. The minimum required for a retrofit is 256 KB (.25 MB). 512 KB (.5 MB) free space (line 1c) should be more than sufficient for a maximum for SMs. SM-2000s would require a larger number. The total NRODD, line 1d, represents the total of NRODD in KB of used + available (free).

If you wish to change the percent free space in this worksheet, you will need to recalculate line 1c. For 25 percent, change line 1c to: (2.5 * line 1b) / 7.5. For 40 percent, change line 1c to: (4 * line 1b) / 6.

If you wish to override the percent free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Technologies Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form 5700-1/2 that is described in the TG-5, Division 8, Section 2, Paragraph 2.18. The Regional Engineer must make the physical change. Remember that all NRODD free space is backup on disk. If you assign 40 percent versus 30 percent free space, you will be backing up a lot more data on disk. Unprotected Office Dependent Data (UODD) growth: UODD is no longer a fixed size per the software configuration ordered. It is variable based upon the specific relations in non-redundant and redundant ODD. The minimum value for retrofits is 100 KB.

10.4.3.3.6 UODD Free Space-Line 2b

For retrofits, the free space will automatically be adjusted below the 30 percent default if 30 percent would require another memory board. Refer to NRODD free space for information on recalculating the free space and overriding the OP MEMSIZE calculation. Remember that OP MEMSIZE will use the same free space

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value for NRODD and UODD. The minimum value for retrofits is 100 KB. UODD free space is not backed up in disk because the data is transient.

10.4.3.3.7 Redundant Office Dependent Data (RODD) Growth

RODD consists of routing information, e.g. office screening and routing tables. Unless there is grow such as an NPA (Numbering Plan Area) split, RODD remains relatively constant. Therefore, a line for grow was not added. OSPS offices, however, may wish to add memory to RODD if they will be installing some of the OSPS special features that reside in RODD.

10.4.3.3.8 RODD Free Space-Line 3b

A minimum of 256 KB (.25 MB) of free space is required. In most cases, the minimum will be the number used because the calculated value is usually less than 256 KB.

10.4.3.3.9 Total ODD-Line 4

Total ODD is the sum of NRODD + UODD + RODD.

10.4.3.3.10 Total Text-Line 5

Total text consists of base text plus peripheral options. Text for equipped peripheral options will be downloaded at the time of retrofit. Appendix A must be completed to calculate total text size. For 5E15, to determine which peripherals are in the SM, you can use the command SMMAP . If you are unsure as to which peripherals are equipped, you may elect to assume that all are equipped when calculating memory required. This assumption will always provide enough memory, but will also over-engineer in most cases. It will way over-engineer loaded SMs because of the number of possible choices.

10.4.3.3.11 Additional Stand Alone Billing (SAB)-Line 7

Additional SAB is an option for all SMs (including remote SMs, host SMs, optically remote SMs and 2-mile remote SMs in 5E5 and later. The amount of available memory for SAB is the difference between the total amount of available memory per number and type of memory boards and line 6. For example, if 32 MB is available (four 8 MB boards) and the total of line is 30.5, there is 32 - 30.5 MB or 1.5 MB available for SAB. If 2 MB is required and only 1.5 MB is available, SAB will get 1.5 MB unless additional memory boards are provided. To determine the amount of SAB memory required for storage of AMA records. The 54 KB of SAB that all SMs receive is the .05 added in Line 6. SM-2000 SMs receive is the .57 added in Line 6.

EXAMPLE

SM Memory Calculation for Basic SM

SM Identifier: SAMPLE BASIC SM 5E14 to 5E15

NRODD

1. 5E14 NRODD

a. OP:ODD, NRODD used value = 980 KB

b. Multiply line 1a by 1.1 for 5E14 EOP

growth = 1078 KB

c. Calculate projected 30 percent free space = 462 KB

(3 * line 1b) / 7

If line 1c < 256 KB, change to 256 KB.

d. Total NRODD (line 1b + line 1c) = 1540 KB

UODD

2. 5E14 UODD

a. OP:ODD UODD used value = 1421 KB

b. Calculate projected 30 percent free space = 609 KB

(3 * line 2a) / 7

If line 2a < 100 KB, change to 100 KB.

c. Total UODD (line 2a + line 2b) = 2030 KB

RODD

3. 5E14 RODD

a. From OP:ODD, RODD used value = 378 KB

b. Calculate projected 30 percent free space = 256 KB

(3 * line 3a) / 7

(If line 3a < 256 KB, change to 256 KB.)

c. Total RODD (line 3a + line 3b) = 634 KB

4. Total ODD in MB 4.12 MB

Use (1d + 2c + line 3c) / 1024

5. Total 5E15 Text 26.08 MB

Complete Appendix A and place total here.

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6. Subtotal for SM memory
(ODD + text + SAB) required = 30.25 MB

(line 4 + line 5 + .05 if SM or .73 if SM-2000)
and RMB .008 if SM or .29 if SM-2000

Line 7 to be added only if additional SAB is required:

7. Additional SAB required
(see SAB below) = 0 MB

8. Total SM memory required (with SAB) = 30.25MB

(line 6 + line 7)

Note: / = divide, * = multiply. Roundup to nearest 100th.
If line 6 is slightly over a board boundary, recalculate NRODD and UODD using 29 percent free (2.9 * line) /7.1. If the total still does not fit, recalculate using 1 percent decrements until there is a fit. If you are not satisfied with the final percent free space, order additional memory. Be aware that NRODD free space < 20 percent will trigger a minor alarm.

Appendix A

1. Base 5E15 Text

a. Input one of the following: 24.75 MB
(basic is 28.07, std is 30.88, loaded is 41.88, signaling is 44.70, SM-2000 is 54.07)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92. 92 KB

If LDSF2 present, enter 660. 660 KB

If RAF present, enter 80. 80 KB

If ISTF present, enter 60. 60 KB

If LDSU or RAF or ISTF present, enter 42. 42 KB

If SAS present, enter 426. 426 KB

If GDSF present, enter 366. _____ KB

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c. Add if Standard or Loaded SM,

If IDCU present, enter 742. _____ KB

d. Add if Loaded SM,

If ISLU present, enter 474. _____ KB

If PI present, enter 218. _____ KB

If PH2 present, enter 1472. _____ KB

If PH3 present, enter 1156. _____ KB

If ISLU2 present, enter 840. _____ KB

If PI2 present, enter 450. _____ KB

If PH4 present, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718.
(Wireless only) _____ KB

e. Add if Signaling SM,

If SS7 on PSU present,
enter 3992. _____ KB

If SM, complete steps f, g and h.

If SM-2000 skip to item i.

f. Calculate total peripheral images
in KB. 1360KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total
in MB = 1.33 MB

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h. Total text (line a + line g) = 26.08 MB

i. If SM-2000

If LDSF, enter 202. _____ KB

If GDSF, enter 366. _____ KB

If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 840. _____ KB

If PI2, enter 450. _____ KB

If PH4, enter 1666. _____ KB

If PHA present, enter 514.
(Wireless only) _____ KB

If PHV present, enter 514.
(Wireless only) _____ KB

If PHV3C present, enter 718
(Wireless only) _____ KB

If SS7 on PSU, enter 3992. _____ KB

j. Calculate total peripheral images
in KB. _____ KB

(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

l. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

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In this case, more than 35 MB is required. The minimum would be 32 MB for the closest memory board boundary. 32 MB - 30.25 MB leaves approximately 1.75 MB for SAB if additional SAB is desired and another memory board is not desired. If more than 1.75MB of additional SAB is desired, another memory board would be needed. Note that for 5E13 a Basic SM requires 36 MB to be equipped. Which means the SMP23CDM Memory Expansion feature must be initiated, a new SM ordered (MCTU3), or consolidation takes place via Project Renaissance to an SM-2000.

10.4.4 5E16.2 SOFTWARE RELEASE

10.4.4.1 HARDWARE

10.4.4.1.1 AM

10.4.4.1.1.1 3B21D AM

The AM is currently equipped with 128MB of memory via a 32 MB core board and three 32 MB Single In-Line Memory Module (SIMM), which is unchanged since the the 5E14 software release.

10.4.4.1.2 Switching Module (SM)

Table 10.4-8 shows the 5E16.2 SMPU configurations.

Table 10.4-8 5E16.2 SMPU Configurations

PROCESSOR [a]		MEMORY BOARDS [b]	MAX. SLOTS [c]	MAX. EQUIPAGE (MB) [d]
SMP23CDMX	68020	TN1423 TN2012		52 5
SMP20 SMP20DC	68020	TN1374 TN1376 TN1661	6 6 6	24 48 96
CORE40	68040	TN1685 TN1806	4 2	128 256
CORE60	68060	TN1685 TN1806	4 2	192 256
SB20CORE	68LC040	KBN20 KBN21 KBN22	1 MM 2 MM 3 MM	 32 64 96
CORE60MM UN 588	68060	TN1685 TN1806	2 2	192 256

Notes:

a. Processor addressability limits: 68012 & 68023 - 32 MB, 68020 - 4 GB,SB20CORE/ CORE40 /CORE60 - 748 MB.

b. TN56 = 2MB, TN2012 = 4 MB, TN1374 = 4 MB, TN1376 = 8 MB, TN1661 = 16 MB, TN1685 =32 MB, TN1423=32 MB, TN1806 = 64 MB. The TN1374,TN1376,TN1661 boards may be mixed in the same MCTU2 (68020). The other boards are not mixable. The TN1423 is a new microprocessor board with dynamic memory. The TN1685 and TN1806 can be mixed in the same CORE40/60. or CORE60MM. The CORE40 has no memory on the processor board; the CORE60 has 64MB on the board, and the CORE60MM can be equipped with 64 MB or 128 MB of memory

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c. Max slots for CORE60 assumes SM-2000 unit. Max slots for CORE60MM assumes SM2005 unit.

d. Maximum equipage (**) requires the use of the MEU (Memory Expansion Unit).Memory totals denote DRAM on processor pack plus all external memory packs

e. The TN1423 is a processor board which supports 32 megabytes of on-board memory; the SMP23CDM does not support external memory boards, the SMP23CDMX supports zero to five TN2012 external memory boards.

10.4.4.1.2.1 TN1423 Microprocessor Board (Feature SMP23CDM)

This feature is also known as SMP23CDM (provided in 5E10) for SMP23 Dynamic Core Memory and provided 32 MB of memory. The feature was ported back to 5E9(1) software release so that offices skipping from 5E9(1) to the 5E10 software release could use it. It was also ported to the 5E9(2) software release because it needs to be added before any retrofit to 5E10. This feature supports the conversion from the SMP12 to TN1423. Prudent use of this board can save money when growing memory. The TN1423 is priced slightly higher than the cost of an MEU and one TN2012. When this board is installed in SMs equipped with TN2012s, the five TN2012s can be used to grow memory in other SMs with MEUs or a few MEUs may be ordered to grow memory in some SMs using the surplus TN2012s. The surplus TN2012 boards can also be used to grow AM memory.

10.4.4.1.2.2 SMP23CDMX

The TN1423 in combination with the TN1408 , the TN1418 and appropriate wiring upgrade comprise the SMP23CDMX. This combination permits the TN1423 to use external memory packs.

10.4.4.1.2.3 Module Control Time Slot Interchange Unit Version 3 (MCTU3)

Non-SM-2000 SMs shipped equipped with the MCTU3 that has a 68LC040 processor (beginning with 5E10 software release update). The MCTU3 has all the existing functionality of the SMP20 plus additional capabilities. It is a one-shelf unit, instead of the two-shelf unit (MCTU2) needed for the SMP20.

10.4.4.1.3 SM-2000 Memory

As part of the 5E11 software release update, a new backplane and compressed shelving is shipped with all new offices. The compressed unit is known as the SMPU5. The CORE60 was shipped with the SM-2000 in all 5E11 orders, regardless of whether the SMPU4 or SMPU5 is equipped. The SMPU4 is equipped with four memory slots. The SMPU5 is equipped with two memory slots. The CORE60 is equipped with the first 64 MB of memory attached to the processor core board. With 128 MB required, two TN1685s can be used or one TN1806. ***Note: If two TN1685s are used in the SMPU5, both memory slots are equipped.*** Note that if an upgrade from a CORE40 to a CORE60 will be ordered for improved real time, some of the 32 MB memory packs will no longer be needed as the CORE60 comes with 64 MB on the processor board.

10.4.4.1.3.1 CORE60MM

The CORE60MM is designed to improve the processor performance and provide two CORE RAM memory configurations of either 64MB (UN594) or 128 MB (UN588). The hardware and associated software for the CORE60MM are are designed to improve the speed of the SM-2000 Switching Module by a factor of 1.8 over the CORE40. The 64MB CORE60MM (UN594) is supported on SM-2000 for software release 5E12. The 128 MB CORE60MM (UN588) is supported on SM2005 for release 5E12. The 128MB CORE60MM (UN588) will be used for all newly shipped SMPU5 offices.

10.4.4.2 SOFTWARE

10.4.4.2.1 Switching Module (SM)

With Software Release 5E16.2, there are five software configurations: basic, standard, loaded, signaling,

and SM-2000. Signaling is a software configuration for VCDX offices equipped with an SM that support SS7 signaling on a packet switch unit (PSU). The signaling configuration has everything from the loaded configuration plus the ability to do SS7 signaling.

10.4.4.2.1.1 Peripheral Image Sizes for 5E16.2

Table 10.4-9 5E16.2 Image Sizes and Configuration Support

IMAGE	KB	BASIC	STANDARD	LOADED	SIGNAL	SM-2000
LDSU	92	□	□	□	□	
LDSF +DSC4	660	□	□	□	□	
RAF	80	□	□	□	□	
ISTF	60 + 42	□	□	□	□	
LDSU, RAF, ISTF **a**	42	□	□	□	□	
IDCU	742		□	□	□	□
GDSF	366	□	□	□	□	□
SAS	426	□	□	□	□	□
ISLU	474			□		
ISLU2	840			□	□	□
PI	218			□		
PI2	450			□	□	□
PH2	1472			□		
PH3	1156			□		
PH4	1666			□	□	□
PH4/ ISDN/ CDMA	4124			□	□	□
PH22	1352			□	□	□
SS7 on PSU	3992				□	□
PHV **d**	514			□	□	□
PHA **d**	514			□	□	□
PHV3C **d**	718			□	□	□
PHV4C **a**	1162			□	□	□
LDSF **b**	202					□
GDSF or LDSF **c**	202	□	□	□	□	□
GDSF + DSC3	568	□				
SLU2	840					□
DNUS	1054					□
ICR	360					□
SCCP	17790					□

Notes:

a. If the SM has LDSU, RAF, or ISTF, the 42 KBs is counted only once. Although LDSU was originally segregated as an option, most SMs will require this option. The few SMs that will NOT require this option are SMs that are only equipped with the older LDSU1. The LDSU1 does not support SS7 functionality.

b. LDSF Functionality is provided with all SM-2000 SMs. Therefore, if you have SM-2000, you will need LDSF with 202 kB and the additional 202 kB if you have GDSF, or LDSF.

c. If the SM has GDSF or LDSF, the 202 kB is counted only once. This code supports the DSC3 functionality.

d. For CDMA in wireless offices only.

10.4.4.2.1.2 Variable UODD

Another change from previous releases is the sizing of unprotected office dependent data (UODD). In software releases prior to 5E9(2), UODD had a fixed size for each SM software configuration. UODD is a variable number. The size varies based upon the specific features and number of lines supported in static ODD (non-redundant and redundant). For example, in the 5E8 software release, the UODD for all Basic SMs was one fixed size of 1304 KB. Now, each SM has a unique size. The office data assembler (ODA) checks all static relations and totals the UODD required to support those static relations. There is a fixed

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association between the static data and the related relations stored in UODD.

10.4.4.2.2 Memory Engineering Guidelines

Some 5E16.2 offices may require more than the physical memory requirement per SM configurations. The variance in total office dependent data (ODD) between offices is growing exponentially due to changes in the marketplace. As customers incorporate changes such as turning offices into "virtual" switches by assigning specific hundreds groups of screening indexes to resellers, for example, the amount of redundant ODD (RODD) increases at a rate never seen before. In other words, translations for routing and screening are being used in "new" ways. As more and more routing and screening data is required with the new competitive environment, more RODD will be required. For these reasons, Lucent is looking for ways to better estimate memory requirements. The existing planning algorithms may need to be changed to account for the wider spread in ODD. Memory requirements for all configurations (especially Basic, Standard, and Loaded) are being investigated. New memory requirements for these configurations are provided as they become available.

The following are the memory engineering guidelines for each of the SM configurations. For each configuration, the software release text (non-ODD) requirement without any optional peripherals and with optional peripherals is given with the default ODD sizes.

Total memory required = text+NRODD+RODD+UODD+SAB+PO.

In order to determine the total amount of memory required, the OP ODD report lists the existing NRODD, RODD, UODD, and SAB. The missing part has always been the text size and now the PO sizes. Base text size is determined by the software configuration. The OP MEMSIZE report lists the software configuration for all SMs in the office. The configuration to size is a look-up function in this command.

The command DUMP:SMMAP can be used to determine the POs that are equipped.

When using the following configuration information , you may refer to Table 10.4-8 for PO sizes. The total memory includes the text, ODD, and SAB listed in the description plus the PO value in the table to determine the total memory (in MB) required.

10.4.4.2.2.1 Basic SM

The 5E16.2 software release text base and patch sizes for the Basic SM are 30.49 MB. The ODD size for 90 percent of the Basic SMs in 5E16.2 is 12.48 MB or less. The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, and HDSU for a total of 1.66 MB. The POs for new ships are assumed to be equipped with LDSU, HDSU, GDSF, and SAS for a total of 1.66 MB. Therefore, most Basic SMs will fit in 44.89 MB (actual) or less (48 MB physical). In SMs, reserved SAB is 56 KB. Also, 48 MB will be the required equipage for 5E16.2. Current data indicates that BSM will exceed 52 MB as ODD grows; therefore, MCTU1s supporting the BSM may be replaced for future memory growth.

This is the last release a MCTU1 will support a Basic SM from a memory standpoint. Unallocated or spare memory is not included in the above numbers.

10.4.4.2.2.2 Standard SM

The 5E16.2 software release text base and patch sizes for the Standard SM are 33.11 MB. The ODD size for 90 percent of the Standard SMs in 5E16.2 is 13.47 MB or less . The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, and IDCU for a total of 2.38 MB . Therefore, some Standard SMs will fit in 49 MB (actual) or less (52 MB physical). In SSMs, reserved SAB is 56 KB. Any Standard SM requires more than 52 MB, especially for SABM required for RSMs. Standard SMs with MCTU1 must be replaced by a MCTU3 or SM-2000 (best choice) prior to retrofitting to 5E16.2.

Unallocated or spare memory is not included in the above numbers.

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10.4.4.2.2.3 Loaded SM

The 5E16.2 software release text base and patch sizes for the Loaded SM are 45.73 MB. The ODD size for 90 percent of the Loaded SMs in 5E16.2 is 17.11 MB or less (17.93 MB or less for OSPS and 8.56 MB or less for TDMA/CDMA). The POs for retrofits are assumed to be equipped with LDSU, RAF, ISTF, HDSU, IDCU, ISLU, PI, PH2 and PH3 for a total of 10.34 MB (5.43 MB of OSPS with no PSU2).

The POs for TDMA/CDMA retrofits are assumed to be equipped with LDSU, ISTF, HDSU, PI2, PH4, PHV, and PHA for a total of 11.43 MB.

Loaded SMs are projected to fit within 76 MB (actual) or less (80 MB physical). For OSPS, most SMs are projected to fit within 73 MB (actual) or less (80 MB physical).For wireless, most SMs are projected to fit within 70 MB (actual) or less (72 MB physical). In SMs, reserved SAB is 56 KB.

Unallocated or spare memory is not included in the above numbers.

10.4.4.2.2.4 Signaling SM

This software configuration has been added for SM and VDCX offices that wish to support SS7 signaling on a Packet Switch Unit (PSU). VCDX offices that do not wish to support SS7 signaling can use the loaded software configuration above. SS7 signaling on PSU requires PH3 protocol handlers.

The 5E16.2 software release text base and patch sizes for the Signaling SM are 45.73 MB. The ODD size for 90 percent of the Signaling SM in 5E16.2 is 13.57MB or less (11.63 MB or less for VCDX) . The POs are assumed to equipped with LDSU, HDSU, GDSF, SAS, IDCU, ISLU2, PI2, PH3, PH4, and SS7 on PSU for a total of 13.82 MB (15.05 MB for VCDX) .

Stand alone billing (SAB) memory has been added to the VCDX offices because they must provide the ability to hold at least 72 hours of billing data in stand alone mode. Since Signaling SMs will not equip all the POs, all SMs are projected to fit within 80 MB (actual) or less (84 MB physical). Wireline Signaling SMs are projected to fit within 76 MB (actual) or less (80 MB physical).

Unallocated or spare memory is not included in the above numbers.

10.4.4.2.2.5 Stand Alone Billing Changes

There is a change taking place with Stand Alone Billing (SAB). This change is being made to enhance the management of memory. Actively managing SAB memory emphasizes the need to monitor memory that would store billing records for the duration of a stand alone. There is no change in that when SAB is set to "YES", all unallocated memory is dedicated to SAB. In the past, it was readily available at ODD growth time, "Auto Shrink". In the future, this memory **will not** be automatically available. SAB will need to be degrown by the amount needed or new memory added, "No Auto Shrink".

NOTE: There will also be an addition to the SM memory layout called Real Time Billing Memory (RTBM). A default amount of memory will be provided for every SM, whether or not the Long Distance Platform, Real Time Call Detail feature is utilized The default size is 8 KB for a SM and 288 KB for an SM-2000.

10.4.4.2.3 SM-2000

The 5E16.2 software release text base and patch sizes for SM-2000 are 60.46 MB. The ODD size for 90 percent of the SM-2000 is 74.03 MB or less (43.81 MB or less for TDMA/CDMA and 78.44 MB or less for VCDX).

The POs for service provider retrofits are assumed to be equipped with LDSF, DSC3, and DNUS for 14.3 MB. The POs for a T/CDMA retrofit are assumed to be equipped with LDSU (DSU2), LDSF+DSC4, ISTF, GDSF=DSC3, PI2, PH4, PHV1, and PHA1 for a total of 17.37 MB. The POs for VCDX retrofits are

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assumed to be LDSF, GDSF, DSC3, DNUS, ISLU2, PI2, PH4, SAS, IDCU, and SS7 on PSU for a total of 22.48 MB.

The SM-2000 is under 164 MB (actual) and 192 MB (physical). The VCDX SM-2000 is under 180 MB (actual) and 192 MB (physical). DNU-S is a heavy memory consumer. Wireline SM-2000s can handle approximately one and one-half fully loaded DNU-S and the VCDX SM-2000 can handle three fully loaded DNU-S. The needs of SM UODD in particular must be taken into consideration. The reserved Stand Alone Billing (SAB) in SM-2000 is 740 KB. Stand Alone Billing (SAB) memory has been added to the VCDX offices because they must provide the ability to hold at least 72 hours of billing data in stand alone mode.

Wireless SM-2000s are experiencing dynamic ODD growth, partly due to the equipage of DNUS, and other ODD impact variables. This volatility along with and close proximity to the board breakage point has prompted the need to grow the physical memory to 192 MB. The ODD for a VCDX varies from 37.47 to 78.44 MB. This variation suggests that a VCDX needs to grow memory to 192 MB to proactively meet this variation.

Unallocated or spare memory is not included in the above numbers.

10.4.4.3 ADMINISTRATION

10.4.4.3.1 Switching Module

10.4.4.3.1.1 SMMAP Command

The SMMAP command, is dump:smmap, sm=x When reading this command, the start and end address of each image and its associated hashsum (parity check for errors) is listed. Many of the peripheral images listed in Table 10.4-6 , are the sum of several individual images that come as a "family". Each member of the family and associated hash sum check are listed in the dump of the SMMAP command.

10.4.4.3.1.2 OP MEMSIZE Command

10.4.4.3.1.2.1 Description

The OP:MEMSIZE command can be used to project memory requirements from release to release. For example, if an office is on software release 5E14 retrofitting to software release 5E16.2, a software update is loaded which contains the memory projections for 5E16.2. When the command is run (i.e. using TORELEASE "5E162"), the new memory requirements are calculated and the hardware is checked to determine if additional memory boards are required before the retrofit. The command may also be used to monitor memory grow within a release (i.e. using TO RELEASE "5E141"). The command also lists on a per SM basis, the type and quantity of all memory packs, the software configuration, and whether additional Stand Alone Billing is set to yes.

10.4.4.3.1.2.2 Input

The OP:MEMSIZE input command is used to list current ODD availability in the AM, SM(s), or CMP, and determine growth values. The format of the command is:

OP:MEMSIZE,TORELEASE="5E???"

NOTE: It is important that the most current issue of the tool be utilized. The tool continues to go through a refinement process to improve accuracy, reflect hardware/software changes or incorporate enhancements/improvements. To identify the latest software update (BWM) loaded use the OP:VERSION command. To see the current and previous two software updates refer to page 1950 on the MCC.

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10.4.4.3.1.2.3 Process

Once the command is input, the program completes the following steps.

(1) Figures the differences between the current relation dictionary file and the target relation dictionary file. If the current and the target are the same then there will be no differences.

(2) Calculates the size of its UODD, NRODD, and RODD relations. Counts the size of each relation that has a relation dictionary file difference and then modifies that total by the difference. For relations with no differences, it just uses the total of the current relation. A minimum of 256K or 30 percent free space is added to the NRODD and the RODD size and 256K or 35 percent free space is added to the UODD size. Note: Free space for the NRODD can be below 30 percent as you will see in the step 5 but the minimum amount of free space for NRODD is 256K. The total of all UODD, NRODD, and RODD relations, including the projection of how they will change in the target generic is reported in KILO ODD NEEDED column.

(3) Adds up the ODD (KILO ODD NEEDED), Text, and Peripherals Images sizes, as well as the minimum SABM. Consider this the Projected size.

(4) Reads GLPMEMSIZE to determine how much memory is in each processor. This is reported as MEG MEM EQUIPPED.

(5) Compares the amount of memory equipped (MEG MEM EQUIPPED) to the Projected (Projected) size the tool has calculated and the Engineering (Engineered) size that it gets from the spec5E file MIN MEMORY row. This is done to decide if the OP:MEMSIZE output should report a YES or a NO in the MEMORY NEEDED column. If the MEG MEM EQUIPPED is: Greater or equal to both the Projected and Engineered size Less than the Engineered size than the MEMORY NEEDED column will report YES.

Less than Projected but greater than the Engineered, the tool will decrease the amount free space in the NRODD (% FREE column) to a 256 K minimum before it reports that there is a memory problem. This is an attempt to get the projected image to fit in the equipped memory. It will not, however, go below the Engineered size.

The greater of Projected and Engineered will be reported in the MEG TOTAL NEEDED (MIN) column.

The % FREE column will be blank if there the MEMORY NEEDED column is YES. The % FREE column will be 30 or less depending if the Projected NRODD size was decreased as described above.

NOTE: When NRODD free space falls below 20 percent or 5 percent, minor or major alarms are activated. The free space calculated by OP:MEMSIZE will automatically set the value for free space for the retrofit. If you wish to override the percent free space that is calculated by the OP MEMSIZE calculation for retrofit, notify your Lucent Regional Engineer to input the value in the EQIM (Switching Module Equipage Form) form. He/she must make the physical change. Remember that all NRODD free space is backup on disk. If you assign 40 percent versus 30 percent free space, you will be backing up a lot more data on disk.

When determining the amount of text memory (base text + Peripheral Options) for each SM in 5E9(2) and later, the list of specific peripherals equipped for each SM is required. When up on 5E9(2) and later, the SMMAP command, can be used to list specific peripherals for each SM.

The STP:MEMSIZE command may be executed to stop the invocation of the tool.

10.4.4.3.1.2.4 Output

To report a forecast summary of the memory needed by the office's AM, CMP, and SMs to retrofit to the specified release. The report contains the current memory sizes of all the processors and sizes needed for

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the target release. Output is sent to the ROP and saved in the /rclog/sodd/ memsize.rep file. The tool will verify if the current and target release data files are available. If not, it will output an error message. The tool will also verify if the hardware on the switch is ready for the retrofit. If not, it will output an error message. Any errors encountered during the execution of the tool on any processor will result in an error message reporting the processors that could not be sized.

The OP:MEMSIZE command will also output the equipment specifics (memory boards & number) for each processor in the office.

10.4.4.3.2 Switch Resource Engineering (SRE) Growable Relations

Another way of keeping memory sizes under control is SRE. A subset of the relations is sized according to individual algorithms, but can be grown (to a larger size) by using recent change view 8.40. The algorithms are designed to accommodate five standard deviations or 99.97 percent of the SMs. A small group of relations require usage data from traffic engineers. Currently, the two relations that require user input are the OSPS relations COINOT and SRVOT. They request the percent of office traffic for coin, MECH, Listing Services, and QUANTUM calls. Refer to recent change view 8.9 for more information.

The need to grow relations is rare, but may be warranted for the following situations:

- If a service requires an unusual number of tuples for call processing such as call transfer tuples for some AIN services or Automatic Call Distribution (ACD). To prevent SM breakage on a relation, the relation may be grown.
- An office is an extreme outlayer in feature usage such as very large ISDN SMs with greater than five calls per hour and greater than 210 second holding times.
- If a relation needs to be grown, contact Lucent Technologies for assistance. Please keep in mind that the number of affected offices is very small.

Relations are grown using the Translation Guide Form 5547 found in Division 3, Section 5AW Contact Lucent Technologies for assistance in determining the correct size if these relations need to be grown. The following table presents the relation acronym (Relation), relation name (Name), specific application(s) (Applic.), and a functional description (Description). The description will also point out if the RC/V name on view 8.40 is different from the relation acronym (RC/V:) and where "usage" plays a role in resource consumption (i.e. high use features). Additional SRE information (currently being modified) may be found in the following document:

- *Recent Change Procedures* 235-118-251 Section 10.34

WARNING: The following relations are grown using the Translation Guide Form 5547 found in Division 3, Section 5AW. Contact Lucent Technologies for assistance in determining the correct size if these relations need to be grown.

Table 10.4-10 5E16.2 Switch Resource Engineering Growable Relations

SWITCH RESOURCE ENGINEERING (SRE) GROWABLE RELATIONS			
RELATION	**NAME**	**APPLIC.**	**DESCRIPTION**
ACRECORD	Auxiliary Call RECORD	OSPS	RC/V: ACRD. Stores information used for billing of an OSPS call
ADB	Analog Data Block	ISDN	Stores data for the Shared DN analog member of an ISDN Shared DN group
APB	Associated Process Block	OSP	Stores FEX (future) model information for OSPS calls
APBUF	Application Processor BUFfer	AP, MSS, EDS	Buffer for messages between AM and SMP
APDU	Application	TR-303 ISDN	Stores information for Automatic Terminal Setup & TR-303

	Processor Data Unit		EOC maintenance messages between RT & *5ESS*® Switch
ASPBASE	Advanced Services Platform BASE	AIN, ASP	Stores info about AIN/ASP transactions.-Usage depends on dialed DN (800 call) & other AIN/ASP trigger rates (LNP) -Number of tuples for NSDB, NS_BILL & NS_IDX are derived from ASPBASE.
ASPTP	Advanced Services Platform Terminal Process	AINASP	
ATCALL	AuTo CALL	MS, EDSStores data for MSS/EDS auto call	
BRCSDB	BRCS Data Block	ISDN	Stores ISDN call feature data - Usage depends on Shared DN & ACD position call rates
CBDB	Call Buildup Data Block	BRCS, ISDN	Stores FEX (feature) data on process stack
CCSSTPDB	CCS SeTup Data Block	SS7	Stores CCS trunk signaling data
CFLNTRM	Call Forwarding LiNe TeRMination	BRCS, CF	RC/V: CFLINT. Stores Call forwarding & another feature data for CF Don't Answer calls
CFSCOP	Call Forwarding System CampOn Process	BRCS, CF	Stores call forwarding, call record & other feature data
CINDX7	SS7 INDeX	SS7	Used for efficient managing ENTRY7 tuples used for SS7 ISUP maintenance messages.
CLDB	Call Leg Data Block	BRCS, ISDN	Stores FEX (feature) model information -Usage depends on Shared DN, line time slot bridging, PRI & ACD position call rates.
COINOT	Coin Originating Treatment	OSPS	Stores data for originating OSPS coin & other call types-Usage depends on coin & MECH call rate.
CPLR	CouPLeR, PRI	ANNMNTS	Used when a many-to-one relation exists between ports & processes such as many customers listening to one announcement or one wide-band call using many trunks/PRIs.
CQB	Circuit Queuing Block	All	Stores information when queuing for a circuit that is already being used.
CRECORD	Call RECORD	Billing	RC/V: CRD. Stores billing information during call Usage depends on call forwarding call rate
CV_STATE	Call Vectoring STATE	OSPS, ACD	RC/V: CVSTATE. Stores data for OSPS ACD call vectoring-Usage depends on time in queue, percent of calls which -terminate to an ACD -first terminate to an Intelligent Peripheral and then transfers the call to an ACD.
DALB	D-channel Application Linkage Block	ISDN	Identifies D-channel message with calls - Usage depends on Shared DN, PRI & ACD position call rates.
DBCND	Data Block Calling Number Delivery	ICLID	Stores last incoming calling DN used by ICLID calling number delivery
DISPDB	DISPlay Data Block	ISDN	Stores display information for CPE - Usage depends on Shared DN & ACD call rates.
E911DB	E911 Data Block	E911	Stores data about E911 calls
ENTRY7	ENTRY SS7	SS7	Tracks SS7 ISUP maintenance (blocking, unblocking & reset) messages.
GPFTIME	General Purpose Functional TIMEr	ISDN	Stores data about timers associated with PRI & BRI/DSL maintenance
ISUDB			
LSCMDB	Large Shared Call Model Data Block	ISDN Shared DN	Stores information about Shared DN group for the Shared DN controlling terminal process
MALLOC	Memory ALLOCation	TR-303 ISDN	Stores information for Automatic Terminal Setup & TR-303 EOC maintenance messages between RT & *5ESS*® Switch used for ASN.1 message en(de)coding
MDB	Model Data Block	BRCS, ISDN	Stores FEX (feature) model Block ISDN information - usage depends on Shared DN, line timeslot bridging, PRI & ACD position call rates

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MSMWIDA	Message Service Message Waiting Indicator DAta	MSS	Stores call information associated with a MWI activate or deactivate request for inter-switch voice messaging (ISVM)
NSDB	Network Service Data Block	AIN, ASP	RC/V: ASPBASE. Stores routing & billing information for SCP initiated routes (AIN/ASP calls)- number of tuples derived from ASPBASE
NS_BILL	Number Service BILLing	AIN, ASP	RC/V: ASPBASE. Stores bill|ng & other information about AIN/ASP trigger part of call - number of tuples derived from ASPBASE
NS_IDX	Number Service InDeX	AIN, ASP	C/V: ASPBASE. Stores data for AIN/ASP calls-number of tuples derived from ASPBAS
OAOTDB	Operator Services Originating Treatment Data Block	OSPS	Stores originating treatment feature information for OSPS T&A calls
OSPCB	Operating System Process Control Block	All	Stores data about operating system processes - Usage depends on call transfer, EDS, ISDN, display, Shared DN, On Demand B-channel & Busy Line/No Answer call rates
OSTCB	Operating System Timer Control Block	All	Stores data about operating system timers-Usage depends on ACD, OSPS, On Demand, B-channel & Busy Line/No Answer call rates
PHDB	PatH Data Block	All	Stores data on SM time slot path
PHISTORY	Port HISTORY	MAINT	Stores information on out-of-service ports OOS for more than one reason
PTRDB	PoinTeRs to Data Blocks	OSPS	Stores pointers to other OSPS data blocks
PU_ENTRY	Pick Up ENTRY	Call Pickup	RC/V: PUENTRY. Stores information on call pickup queued call
QRYDB	QueRY Data Block	OSPS	Stores data saved across transition strings for the FEX (feature) QUERY mode used when querying the SCP during OSPS calls.
QV_STATE	Queuing & Vectoring STATE	ACD BRCS	RC/V: QVSTATE. Stores data for ACD BRCS call vectoring & ACD BRCS standard queuing - Usage depends on time in queue, percent of calls which: - terminate to an ACD - first terminate to an Intelligent Peripheral, and then transfers the call to an ACD.
RTLB	Remote Terminal Linkage Block	TR303 ISDN	Stores information for Terminal ISDN Automatic Terminal Setup & TR-303 EOC maintenance Block messages between RT & *5ESS*® Switch.
RTMSGBUF	Remote Terminal MeSsaGe BUFfer	TR-303 ISDN	See RTLB
SCMDB	Shared Call Model Data Block	ISDN Shared DN	Stores information about Shared DN group for the Shared DN controlling terminal process
SDAP_SDL	Speed Dial Auto Provisioning Speed Dial List	OSPS	RC/C: SDAP. Stores data when updating the speed dial list used for OSPS AT&T calling card calls
SRVOT	SeRVices for Originating Treatment	OSPS	Stores data for listing services calls for originating treatment and EIS interface - Usage depends on listing service call rates
TATDB	Terminating Attempt Trigger Data Block	AIN ASP	Stores data about AIN/ASP calls which hit a termination trigger
TN_INFO	Termination Notification	AIN ASP	Stores data about an AIN/ASP SCP query

10.4.5 Memory Worksheet 5E16.2

The following worksheet can be used to project 5E16.2 SM memory sizes from 5E14 or 5E15 SM memory sizes using output from the OP ODD report. For line 1b, feel free to use any growth factor that you deem appropriate. The worksheet defaults to 10 percent.

Worksheet SM Identifier_____

RODD

1. Current NRODD

a. OP:ODD, NRODD used value = _____ KB

b. Yearly NRODD growth rate due to
subscriber line additions and moves
(default=5 percent) = _____ %

c. Years (or fractions thereof) between
OP:ODD report date and 5E16.2 retrofit
date (default = 0.5) = _____ YR

d. Expected NRODD size immediately prior to
5E16.2 retrofit
(line 1a * (1+ (line 1b * line 1c))) = _____ KB

e. Multiply line 1d by appropriate retrofit
factor from the Retrofit Factors for ODD Memory Areas Table
(line 1d * retrofit factor) = _____ KB

f. Calculate projected 30 percent
free space = _____ KB

(.03 * line 1e

If line 1f < 256 KB, change to 256 KB.

g. Total NRODD (line 1e + line 1f) = _____ KB

UODD

2. Current UODD

a. OP:ODD UODD used value = _____ KB

b. Multiply line 1d by appropriate retrofit
factor from the Retrofit Factors for ODD Memory Areas Table
(line 2a * retrofit factor) = _____ KB

c. Calculate projected 30 percent
free space = _____ KB

(3 * line 2b) / 7

If line 2a < 100 KB, change to 100 KB.

d. Total UODD (line 2b + line 2c) = _____ KB

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RODD

3. Current RODD

a. From OP:ODD, RODD used value = _____ KB

b. Yearly RODD growth rate due to
office trunk additions and
routing translation changes

(default=5 percent) = _____ %

c. Years (or fractions thereof) between
OP:ODD report date and 5E16.2 retrofit
date (default = 0.5) = _____ YR

d. Expected RODD size immediately prior to
5E16.2 retrofit
(line 3a * (1+ (line 3b * line 3c))) = _____ KB

e. Multiply line 1d by appropriate retrofit
factor from the Retrofit Factors for ODD Memory Areas Table
(line 3d * retrofit factor) = _____ KB

f. Calculate projected 30 percent
free space = _____ KB

(.03 * line 3e

If line 1f < 256 KB, change to 256 KB.

g. Total NRODD (line 3e + line 3f) = _____ KB

4. Total ODD in MB _____ MB

Use (1g + 2d + line 3g) / 1024

5. Total Next Software Release Text
(text/patch + po)= _____ MB

Complete Appendix A and place total on
Line 5.

6. Subtotal for SM memory
(ODD + text + PO + SAB) required = _____ MB

Line 4 + Line 5 + for SAB .05 if SM or .73 if SM-2000
and for RTBM : .008 if SM or .29 if SM-2000)

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)

Line 7 to be added only if additional SAB is required:

7. Additional SAB required
(see SAB below) = _____ MB

8. Total SM memory required (with SAB) = _____ MB

(line 6 + line 7)

Note: / = divide, * = multiply. Roundup to nearest 100th.
If line 6 is slightly over a board boundary, recalculate NRODD and UODD using 29 percent free (2.9 * line) /7.1. If the total still does not fit, recalculate using 1 percent decrements until there is a fit. If you are not satisfied with the final percent free space, order additional memory. Be aware that NRODD free space < 20 percent will trigger a minor alarm.

Appendix A

1. Base Software Release Text

a. Input one of the following: _____ MB

(basic is 28.07, standard is 30.88, loaded is 41.88, signaling is 44.70, SM-2000 is 54.07)

b. Add if Basic, Std, or Loaded SM,

If LDSU present, enter 92. _____ KB

If LDSF2 present, enter 660. _____ KB

If RAF present, enter 80. _____ KB

If ISTF present, enter 60. _____ KB

If LDSU or RAF or ISTF present, enter 42. _____ KB

If SAS present, enter 426. _____ KB

If GDSF present, enter 568. _____ KB

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c. Add if Standard or Loaded SM,

If IDCU present, enter 742. _____ KB

d. Add if Loaded SM,

If ISLU present, enter 474. _____ KB

If PI present, enter 238. _____ KB

If PH2 present, enter 1474. _____ KB

If PH3 present, enter 1464. _____ KB

If ISLU2 present, enter 840. _____ KB

If PI2 present, enter 426. _____ KB

If PH4 present, enter 2546. _____ KB

If PHA present, enter 546.
(Wireless only) _____ KB

If PHV present, enter 546.
(Wireless only) _____ KB

If PHV3C present, enter 734.
(Wireless only) _____ KB

If PHV4C present, enter 1866.
(Wireless only) _____ KB

e. Add if Signaling SM,

If SS7 on PSU present, enter 3650. _____ KB

If SM, complete steps f, g and h.
If SM-2000 skip to item i.

f. Calculate total peripheral images
in KB. _____ KB

(Add all values for b + c + d + e)

g. Divide line f by 1024 to get total

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in MB = _____ MB

h. Total text (line a + line g) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

i. If SM-2000,

If LDSF, enter 202. _____ KB

If GDSF, enter 366. _____ KB

If LDSF or GDSF, enter 202. _____ KB

If DNUS, enter 1054. _____ KB

If SAS, enter 426. _____ KB

If IDCU, enter 742. _____ KB

If ISLU2, enter 840. _____ KB

If PI2, enter 426. _____ KB

If PH4, enter 4014. _____ KB

If PHA present, enter 546.
(Wireless only) _____ KB

If PHV present, enter 546.
(Wireless only) _____ KB

If PHV3C present, enter 734.
(Wireless only) _____ KB

If PHV4C present, enter 1866.
(Wireless only) _____ KB

If PHV5C present, enter 3416.
(Wireless only) _____ KB

If SS7 on PSU, enter 3650. _____ KB

j. Calculate total peripheral images
in KB. _____ KB

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(Add all values for i)

k. Divide line j by 1024 to get total
in MB = _____ MB

l. Total text (line a + line k) = _____ MB

ENTER THIS TOTAL ON LINE 5 OF MAIN WORKSHEET.

Table 10.4-11 Retrofit Factors for ODD Memory Areas

Retrofit	Configuration	NRODD	UODD	RODD
5E14 to 5E16.2	Basic	1.0447	1.3358	1.0162
	Standard	1.0171	1.0627	1.0223
	Loaded	1.1770	1.2168	1.0161
	Signaling	N/A	N/A	N/A
	SM-2000	1.1164	1.1000	1.0160
5R15 to 5E16.2	Basic	1.0125	1.0509	1.0084
	Standard	1.0224	1.2880	1.0098
	Loaded	1.0493	1.2207	1.0066
	Signaling	N/A	N/A	N/A
	SM-2000	1.0529	1.1011	1.0083

10.4.6 Patch Space Recovery Feature

In order to provide new features without requiring SM memory upgrades, and in order to provide extended life on one release, the SM patch space used by software update is being reduced. Software updates use and fragment this available patch space as they claim memory space for changed software and reclaim space vacated by old versions of the replaced software. At some point, the patch space available becomes so fragmented with small spare holes that there are either not enough spare patch holes or large enough holes to accommodate the memory needs of a Feature Release or Software Update.

This feature rearranges the text portion of the SM memory image, thereby recovering the spare patch holes into a contiguous patch space allowing the *5ESS*® switch release to be maintained via SU for an extended period of time. This feature has the following characteristics:

- Stable Calls not affected
- It is not a retrofit procedure: no new or changed functionality being introduced as part of this procedure. Only the text image of the SM is regenerated which greatly minimizes off-line pump time
- Patch space usage is evaluated automatically as part of every SU Official stage and a report (with minor alarm) is output to recommend procedure
- Can select SMs individually, either by SM or SM-2000 configuration
- Actual SM simplex time is approximately 20 to 30 minutes for the SM configuration and approximately 10 minutes for the SM-2000 configuration
- SMs are in "image diff" mode, which is a quick fall-back recovery psuedo-duplex mode during the **activate soak** stage of the procedure

- SM text image regeneration to recover patch space is performed as a non-intrusive operations during the **prepare** stage of the procedure.

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10.5 SM OVERLOAD CONTROLS

10.5.1 DEFINITION

Overload is the *5ESS*® switch condition that occurs when both the call processing and noncall processing loads offered to the system exceed its capacity. The overload condition must be detected and controlled before performance degrades.

There are two types of overload: real-time overload and shared-resource overload. Real-time overload occurs when there is insufficient time for the processor to perform all the work offered to the system. This is the primary overload critical to the system performance, which, if not corrected, leads to delays degrading system performance. Shared resource overload occurs when there is a shortage of shared software resources requested by processes in the system. The tone decoder is the only monitored hardware resource contributing to the resource overload. This type of overload hampers further processing.

In general, a real-time overload is usually caused by the surge of call traffic. A shared resource overload, on the other hand, is usually caused by inadequate resource allocation. However, either overload type can be caused by a software fault.

10.5.2 OBJECTIVES AND STRATEGIES OF OVERLOAD CONTROL

The general objective of overload control is to maximize system performance during periods of overload. More specifically, the purposes of overload control can be stated as follows:

- Ensuring system sanity and responsiveness
- Maintaining a high level of call processing
- Providing a graceful degradation of service, if degradation is inevitable.

To achieve these objectives, the overload control program constantly monitors the usage of the processor real time and the shared software resources. Overload control averages the usage over an appropriate time interval and compares the result with thresholds to determine the presence and the severity level of an overload. Overload control initiates appropriate actions to eliminate or minimize the effect of the detected overload conditions. These actions are a series of incremental controls ensuring a stable level of system performance with graceful degradation, if performance degradation is inevitable.

When real-time overload is detected, the general strategy is to:

- Limit the input of call processing work and, if necessary, the noncall processing work
- Defer the nonessential noncall processing work
- Ensure that a minimum of essential system checks are run to maintain the system sanity.

When resource overload is detected, the general recovery strategy is to:

- Identify and eliminate any resource hog to recover the overloaded resource
- Run sanity checks on the usage of this resource and correct the causing errors
- Reduce call processing and noncall processing activities which require this resource.

All of these control actions are fully automatic and require no immediate intervention by the central office

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craftsperson or surveillance center. However, the operating personnel are informed by overload control about the overload type, overload level, and the control actions. Upon each occurrence or state change of the overload, the master control center (MCC) display pages are updated. Within each 15-minute period, a message is printed at the receive-only-printer (ROP) once an SM goes into overload, if the overload escalates, or if the SM goes out of overload completely. The status of each SM still in overload at the end of a 15-minute period is printed at the ROP along with the overload history report.

10.5.3 SWITCHING MODULE OVERLOAD CONTROL

The SM overload control checks for the following types of overload:

- ***SM Real-Time Overload:*** The SM real-time overload exists when the SMP lacks sufficient real time to complete all of the work queued without excessive delays.

- ***SM Shared Resource Overload:*** The SM shared resource overload occurs when the shared software resources required for call processing in the SM are not available because they have been previously allocated for existing calls. The only SM hardware resource monitored for overload is tone receivers. In all software releases, the SM software resources monitored for overload are the message control block (MCB), process control block (PCB), stack control block (SCB) and timer control block (TCB). Several additional software resources related to call features are monitored by overload control.

10.5.3.1 Approach

To respond quickly to a sudden surge in work load, SM real-time overload control monitors SMP real-time usage every 6 seconds. However, to avoid a rapid oscillation of overload states due to statistical fluctuations of call traffic, some hysteresis is built into the overload control mechanism. Overload control compares a moving average real-time usage of four 6-second intervals to predetermined thresholds for determining the overload level. In addition, the overload state changes only at 18-second intervals. That is, once in overload, the current level lasts for at least 18 seconds before it can change to another level. Even under the most severe overload level, the SMP still can process a large amount of call traffic.

10.5.3.2 Overload Levels

There are four overload states for SM real time. The states and their corresponding control actions are listed as follows. The various control actions are described in more detail in the *Details of Control* section.

- NONE: There is no SM real-time overload. The SMP has adequate real-time reserve to maintain its normal performance. All processing delays are minimal.

- MINOR: The SMP experiences a mild, real-time overload condition. At this level, the SM relies on the automatic tightening of the peripheral control (PC) throttle to reduce the originating and incoming traffic. There are no additional control actions, and this level serves as a high traffic warning.

- MAJOR: In a MAJOR overload condition, the PC throttle for originating and incoming calls is tightened further to reduce the traffic input. Nonessential tasks (DNET) in the SM are deferred DNET. The SM also requests the CMP to start avoidance routing (AVRT) in an attempt to reduce the amount of outgoing trunk calls passing through the SM.

- CRITICAL: A critical overload is the most severe SM real-time overload. In a CRITICAL SM real-time overload, AVRT and the deferring of nonessential tasks (DNET) are still in effect. However, the PC throttle is overridden by a "super throttle". Reduced Input Acceptance Rate (RIAR). the "super throttle", takes control and provides a strict, fixed level of the traffic input (both line originations and trunk originations) into the SM. The overloaded SM broadcasts to all other SMs to start call-gapping for the calls destined to it.

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During extreme system overload conditions such as emergency situations, lines designated "essential" receive a faster service request response than nonessential lines.

To maintain the sanity of the switch, it is necessary to ensure that a minimum amount of real time is allocated to essential low priority tasks. Since call processing runs at higher priorities and may entirely squeeze out the lower priority work, overload control must ensure the realization of this essential minimum allocation. The real-time overload states and their transitions are defined in terms of the amount of real time available in 6-second intervals for low-priority processes, such as various audits, mate memory check, and recent changes. These audits are used to detect and to recover from data errors so that the system is not adversely affected. Execution of these noncall processing activities is essential to maintaining the sanity of the switch.

MINOR overload corresponds to about 9 percent of SMP time available for low priority tasks during the last 24 seconds, which is equivalent to a printed SMP occupancy of about 91 percent. MAJOR overload corresponds to about 7 percent for low priority tasks, which is equivalent to about 93 percent of SMP occupancy. CRITICAL overload corresponds to about 5 percent for low priority tasks, equivalent to about 95 percent of SMP occupancy.

10.5.3.3 Details Of Control

10.5.3.3.1 Essential Service Protection (ESP)

The ESP provides priority service to subscriber lines designated by the administrative personnel as "essential." The ESP has traditionally been assigned to subscriber lines with critical emergency functions (police, fire, hospital, network controls, etc.). During system overload conditions (as emergency situations), ESP provides priority subscriber lines faster service request response (shorter dial tone delay) than non-ESP subscribers. When operations personnel enable ESP during overload, dial tone delay is minimized on essential subscriber lines receiving priority origination service. Since the number of lines marked as essential is typically less than 10 to 20 percent, the actions of ESP has limited impact on the quality of service to nonessential lines during overloads, and no impact at all during normal loads.

10.5.3.3.2 PC Throttle for Call Originations

To ensure that each new call is processed properly with minimum delay, an effective control mechanism for the acceptance rate of these new call originations (either originating line or incoming trunk calls, circuit-switched or packet-switched, CCS or non-CCS, etc.) is required. Otherwise, either an instantaneous call arrival rate or a sustained heavy call load can cause too many calls to be processed simultaneously and can result in misdirected or lost calls. Therefore, a self-limiting throttle for call originations, the "PC throttle," limits the maximal input acceptance rate to the SM.

Call originations (both line originations and incoming trunk originations) are throttled by way of a PC variable called *PCc*. Each time a call is originated, PCc is decremented by some amount (for example, 100). If PCc is below a certain number (for example, 100), no originations are allowed and the new call arrivals must be queued. This waiting contributes to the major part of dial tone delay for line calls. To allow further calls to be processed, roughly speaking, PCc is incremented (for example, by 100) whenever the SMP has finished the immediately pending call processing work in the last 100 milliseconds. However, the PCc is not allowed to increase beyond an upper limit (for example, 500).

This PC throttle automatically adjusts the call input rate and is closely related to the amount of real time available for the lower priority tasks. When the call load on the SM is well below capacity (that is, SM has real time available and SM occupancy is quite low), the PCc value remains near its upper limit most of the time. This allows the SMP to reach a maximal rate for new call originations. On the other hand, as more calls are allowed to originate, the resultant call processing requires additional real time and thus slows down the rate at which the PCc variable is incremented. This, in turn, reduces the acceptance rate for new call arrivals. Therefore, when the SM is in MINOR/MAJOR real-time overload, the PC throttle automatically tightens up to reduce the new call originations.

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10.5.3.3.3 Defer Nonessential Tasks (DNET)

Many tasks normally performed can be deferred indefinitely during an overload condition. These nonessential tasks consist of the following:

- ***Switch Maintenance/Diagnostics:*** During SM overload, the acceptance and execution of the maintenance and diagnostic requests are greatly reduced.

- ***Terminal Maintenance:*** Terminal maintenance is responsible for protecting against degraded service due to problems in trunks, lines, service circuits, and signaling paths. Terminal maintenance performs fault detection, sectionalization, and isolation. The following terminal maintenance work is inhibited during both AM and SM real-time overloads:

  - ***Automatic Line Insulation Test (ALIT):*** The ALIT provides tip-to-ring, tip-to-ground, and ring-to-ground leakage tests

  - ***Automatic Progression Test (APT):*** The APT routinely tests trunks, identifies trunk signaling problems, and removes faulty trunks from service.

  During an AM real-time overload, all ALIT and APT work for all SMs is inhibited. During an SM real-time overload, ALIT and APT work is inhibited on an individual SM basis. If the line or trunk to be tested is in an overloaded SM, the tests are not performed.

- ***AVRT:*** For 1-way outgoing trunks (hunted ports), it is possible for the CMP to route calls around overloaded SMs. When an SM goes into a MAJOR/CRITICAL real-time overload, or resource overload, AVRT is activated in the CMP by way of a request from the overloaded SM. In AVRT, the CMP makes 5 attempts to hunt for an idle trunk group member not in the overloaded SM. If this hunt fails, the CMP routes that call through the overloaded SM. However, when the SM is in CRITICAL real-time overload, the AVRT-attempted trunk call may be subject to yet another AM throttle for the termination requests.

- ***Reduce Termination Requests (RTRs):*** A call termination request for either a terminating line call or an outgoing trunk call is sent from AM to SM for each terminating call. When an SM is in CRITICAL real-time overload, the SM requests the AM to activate the termination request throttle for the overloaded SM. The AM then starts to throttle the termination requests according to a set of predetermined rates. There are four levels of this throttle. The throttled calls are sent to reorder immediately without being queued for retry. Certain types of calls receive preference in getting through this throttle, such as 911- and 0- calls.

  The termination request throttle as described remains in effect for the outgoing trunk calls. In addition, a new throttling mechanism is initiated for line termination requests. A line termination request is sent directly from the routing SM to the terminating SM, no longer going through the AM. When the terminating SM is in CRITICAL real-time overload, the SM requests all other SMs to start throttling all the line termination requests destined for the overloaded SM. Because of the fully distributed nature of the routing data base for the terminating line calls, every SM except the RSM could serve as a routing SM for some line termination calls. The four levels of this throttle are functions of the total number of SMs in the switch. The throttled calls are sent to reorder immediately without being queued for retry.

- ***Override PC Throttle or Reduce Input Acceptance Rate (RIAR):*** When an SM is in CRITICAL real-time overload or in SM resource overload, the dynamic PC throttle for call originations is overridden by a deterministic overload control "super throttle." The call originations (including both lines and trunks) are then reduced to a fixed level of 1800 calls per hour instead of the self-adjusting throughput of the dynamic PC throttle.

10.5.3.4 Most Severe State

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One of the objectives of overload control is to maintain a high level of call processing even under the most severe overload situation. At the most severe state of SM real-time overload, both the overload control super throttle for originations and the termination request throttle are activated. The overload control super throttle allows 1800 call originations per hour into the SM while the tightest level of the termination throttle allows 7200 call terminations to the SM. This final traffic level is limited to about 4500 full calls per hour for an SM experiencing even the worst possible real-time overload conditions.

10.5.3.5 General Comments on SM Real-Time Overload

The following are comments regarding SM real-time overload:

- ***Symptoms of Real-Time Overload:*** During periods of overload, the subscriber may experience delays in dial tone on some calls. Some calls may receive reorder treatment due to the possible call termination throttling or LU termination blockage.
- ***ESP:*** For those exchanges with ESP enabled, those subscribers designated as "essential" are given preferential originating treatment during system overloads.
- ***Minor Real-Time Overload:*** The short duration of a MINOR overload is usually caused by uneven traffic bursts. It is just a high traffic warning; no actions are required.
- ***Major Real-Time Overload:*** Administration and maintenance inputs (such as recent change, diagnostics) should be deferred to a later nonoverload period.
- ***Frequent Overloads:*** When a frequent (for example, daily) or a long duration (for example, 20 minutes) of MAJOR/CRITICAL overload is experienced, the possible causes of overloads should be investigated (for example, traffic, data base errors, software bugs, hardware faults, etc.) If the cause is traffic, the administrator may consider transferring some of the call load to another SM or look into adding speedup to the SM, if doing so is feasible.
- ***SM Initialization:*** This is usually caused by software or data base problems or both, and extremely unlikely to be caused by call processing.

10.5.4 SM RESOURCE OVERLOAD CONTROL

Four types of shared SM resources are monitored by overload control:

- Basic data blocks and tone decoders
- Feature data blocks
- ISDN queues
- Packet switch unit resources.

It is possible to increment the number of certain SM software resources if they become exhausted and cause overload conditions.

10.5.4.1 Basic Data Blocks

This group of shared software resources is common to all basic call and noncall processing; included are the MCB, PCB, SCB and TCB. Every 6 seconds overload control monitors the count of free resources for each type. If the free count is less than the threshold, SM enters resource overload for that type.

Upon entering resource overload, the SM takes the following actions to alleviate the overload condition and to recover the resource:

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- SM requests CMP to start AVRT
- SM overload control overrides PC throttle to greatly reduce the rate of call originations allowed into the SM
- SM notifies the system integrity monitor. Running at the highest priority, the integrity monitor starts to identify and eliminate the resource hog(s) to recover the nearly exhausted resource, if appropriate.

If any of the resources are exhausted before being detected by overload control, the integrity monitor is informed immediately by the encountering process and takes immediate recovery action.

If the PCB or TCB resource becomes low so as to cause overload or even total resource exhaustion, it will be possible to add in more PCBs or TCBs on a SM. This is discussed in Section 10.5.4.7 , *Software Engineerable Resources* .

10.5.4.2 Tone Decoder (Receiver) Overload

A tone decoder is required for decoding the digits for calls; however, digits coming through an immediate start trunk are handled by the signal processor, not by a tone decoder. The SM tone receiver or tone decoder overload is detected through the number of idle receivers. When tone decoders run out, the permanent signal timing and partial dial timing are shortened (for example, from 20 seconds to 10 seconds) to expedite the freeing of the receivers. When the number of idle tone decoders increases over a threshold value, the timing values are changed back to normal.

10.5.4.3 Feature Data Blocks

This group of shared resources is mainly required by the BRCS and integrated service digital network (ISDN) feature applications. Many dynamic data blocks are included in this group:

- Analog data block (ADB)
- Auxiliary process block (APB)
- BRCS data block (BRCSDB)
- Called buildup data block (CBDB)
- Channel control block communication region (CCBCOM)
- Channel data block (CHDB)
- Calling leg data block (CLDB)
- CPLR
- D-channel application linkage block (DALB)
- Display data block (DISPDB)
- E911 data block (E911DB)
- Large shared call model data block [LSCMDB]
- Model data block (MDB)
- Path data block (PHDB)
- Shared call model data block (SCMDB)

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- Time slot data blocks (TSDB).

Depending on the degree of penetration of individual features, the allocation of these resources is calculated dynamically and may vary greatly. The individual resource is monitored immediately following the occurrence of resource exhaustion. During monitoring, if the free count of the resource indicates one unit block available, the SM reports resource overload for this resource and overload control informs system integrity monitor to trigger appropriate recovery action.

If the number of any of these resources becomes so low as to cause overload or even total resource exhaustion, it will be possible to add in more of the resource. This is discussed in Section 10.5.4.7 , *Software Engineerable Resources* .

10.5.4.4 ISDN Queues

This group contains five queues or buffers which are used for both circuit-switched and packet-switched ISDN call setups. These are BRI/DSL input buffer (DIB), EDSL input buffer (EDIB), Packet-switched line input buffer (XPIB)., packet-switched trunk input buffer (PTIB) and Packet Buffer (PkB). They are used for buffering BRI/DSL circuit-switched call setups, PRI circuit-switched call setups, packet-switched line call setups, packet-switched trunk call setups, and PH-to-SMP packets, respectively. Each queue length is monitored by overload control every 6 seconds. When an SMP experiences real-time overload, these queues may start to grow. When the queue length exceeds certain thresholds, overload control reports resource overload for the queue and requests that PHs start to throttle new call setup messages. Both the thresholds and throttle levels are incremental.

10.5.4.5 Packet Switch Unit Resources

The packet switch unit (PSU) is the central component in the SM for providing packet switching services in ISDN applications. The PSU contains one packet interface (PI) and up to 80 protocol handlers (PHs). It is recommended to reserve one spare PH per shelf for each PH hardware type equipped on that shelf. The PI serves as the gateway between the SMP and the PHs for call processing, signaling, and control messages. Both real-time and shared buffers in every PH and in the PI are monitored by overload control at 3-second intervals. If, in any PH or PI, the real time is near exhaustion or the count of free resources goes below predetermined thresholds, that PH or PI enters overload. When the PI or any PH is in overload, a summary indication of resource PSU overload is printed with the SM number indicated. To determine the status of the overloaded PI or PHs, see TRFC30 report sections 51, 52 and 68.

In general, when a PH is in general overload, overload control starts to incrementally throttle the rate of serving new data packets and new packet-switched call setups offered to that PH. However, when a PH is in extreme overload, circuit-switched call setups also are throttled. When the PI is in overload, overload control starts to incrementally throttle the rate of new call setup requests including both CS and PS entering the overloaded PSU through all access PHs.

10.5.4.6 General Comments on SM Resource Overload

Although real-time overload is usually caused by high call traffic, SM resource overload (except PSU overload) is usually caused by the inadequate allocation of resources, or improper engineering of the equipment on the SM, or in some cases by software problems.

A PSU overload means either one or more PHs or the PI is in overload (either real-time or resources). A PH or PI overload is usually caused by high volume of packet-message traffic. The TRFC30 report sections 51, 52, and 68 describe the packet traffic and processor status for the overloaded PI or PH(s). If any PH frequently enters overload, it should be deloaded.

Some resource overloads may be caused by processor real-time overload. For example, the overload of five ISDN queues: DIB, EDIB, XPIB, PkB, and PTIB is usually caused by the SMP real-time overload. The PSU overload may also be caused by the real-time overload of the PI or one or more PHs.

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10.5.4.7 Software Engineerable Resources

It is possible that there are some application(s) with high feature usage running on a SM that could result in some software resources becomes exhausted, resulting in SM resource overload as discussed. Past experience shows that this occurs very rarely. However, there are certain resources, called Software Engineerable Resources (SER), for which there are procedures for allocating additional data blocks (and thus stopping the overload) in case exhaustion does occur. The SER types include all data structures given in Section 10.5.4.3 , *Feature Data Blocks* plus the PCB and TCB from Section 10.5.4.1 , *Basic Data Blocks*. The following subsections describe how to (1) estimate the additional number of SER data blocks needed to be added in the event exhaustion occurs and (2) how to add in the incremental data blocks. These procedures are part of a methodology which is known as Software Resource Engineering (SRE).

As a caution, before adding in extra data blocks it should be made sure that they are really needed. In the procedures below there are checks which are made to verify that the resource exhaustion does result from a high usage feature and is not due to some software or data problem. However, even if it is found that there is a true resource exhaustion, the exhaustion may occur so infrequently and/or its duration may be so short that it is not worth adding the extra resources. Once the additional data blocks are added in, only a generic retrofit can deallocate the memory assigned to the data. Thus care must be taken that the correct number of data blocks is added in. To help prevent the addition of a large and unnecessary number of data blocks, the following procedures describe how to limit the increase in the number of data blocks to 50 per Recent Change update.

10.5.4.7.1 Determining the Number of Additional Data Blocks Needed

This section discusses how to determine the number of additional data blocks which are needed when a given SER type is exhausted. The steps are as follows:

(1) It should be verified that the resource exhaustion is due to some high usage feature and that adding in more data blocks will solve the problem (the SRE procedures should not be used to fix a software or data problem). In the following steps there are checks listed that help verify this to be the case. Also make sure that the frequency and/or duration of the exhaustion is high enough to warrant adding the additional resources.

(2) After it has been determined that additional resources are required, the total number of data blocks of the SER type which are needed must be calculated using the appropriate algorithm. To do this contact the next level of support in order to obtain and get help in using the algorithms. Once the calculation has been performed, call the result of the calculation (the total number of data blocks of the SER type which are needed) TNN (Total Number Needed).

(3) In RC view 8.40 enter the SM number and SER type, the result of this step being the value displayed for the total number of data blocks of the SER type currently allocated on the SM. Call this result CTN (Current Total Number). This total number should be the sum of the number given by the algorithm when the default "usage" parameter values are used as input plus the number of data blocks which have been previously added manually (the value given by the incremental field in RC view 8.40). Note that for some SER types, the total number displayed may be the above sum rounded up to fill the last data page.

(4) Subtract the result of step 3 (CTN) from the result of step 2 (TNN), this final result being the number of additional data blocks of the SER type which need to be added on the SM. Call this final result ANN (for Additional Number Needed). ANN must be a positive number. If ANN is a negative number, then recheck the estimates of the "usage" input parameters and also the calculation. If the recheck still gives a negative result then contact the next level of support or the person who performed the algorithm calculation. Also if ANN turns out to be greater than 20% of CTN, then recheck the "usage" input parameters and the calculations. If the recheck still gives a result greater than 20% then contact the next level of support or the person who performed the algorithm calculation.

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10.5.4.7.2 Adding Data Blocks

At this point the number of data blocks of the SER type to add on the SM has been determined. Next the number of SER data blocks on the SM must be incremented by this value. The steps to do this are as follows:

(1) Go to RC view 8.40 and enter in the SM number and SER type name. The current value for the incremental number of data blocks will be displayed. Call the result of this step CIN (Current Incremental Number). This field will be zero unless the number of data blocks for the SER type has been manually incremented previously.

(2) Take the final result (ANN) from the last step (step 4) of the previous section 10.5.4.7.1 , *Determining the Number of Additional Data Blocks Needed*, and add it to the result of step 1 (CIN), the sum being the result of this step. Call this result INN (Incremental Number Needed).

(3) Update the incremental field to the result (INN) obtained from the previous step. If the difference between INN and CIN is greater than 50 then multiple updates are needed as there is an upper limit of 50 data blocks which can be added per update.

(4) After an update has completed, the total field value should also have been increased by the same amount as the incremental field has been increased by (because of data page rounding effects it is possible that the new total value could be unchanged from its value before the update or could have been increased by more than the amount by which the incremental field was increased). When all the updates are done there should no longer be any overloads of this SER type on the SM. If the overloads continue, do not keep on adding data blocks as there could be software problems. If the number of data blocks is believed to be reasonable and overloads continue, then contact the next level of support.

10.5.5 OVERLOAD CONTROL FOR ISDN CALLS

Digital ISDN lines offer both CS calls and PS calls through the Q.931 and X.25 protocols, respectively. Both types of calls are processed by SMP to provide call setup. For PS calls, once the call is set up, the data packets are routed by the autonomous PHs without further use of SMP resources.

10.5.5.1 Circuit-Switched Call Setup

The initial CS call setup message (Q.931) from a user BRI/DSL arrives at one of the access PHs, is routed to the PI, and finally is queued in the DIB for SMP processing. When the DIB is in overload, new CS call setup messages are incrementally throttled in the access PHs. When PI packet buffer (PkB) is in extreme overload, the new CS call setup message is denied in the access PHs. In addition, CS call setups are also affected by the most severe state of PH overload.

10.5.5.2 Packet-Switched Call Setup

The PS call setup message (X.25) comes from a user BRI/DSL arrives at one of the access PHs, proceeds to PI, and finally is queued in the XPIB for SMP processing. When the XPIB, PI processor, PI PkB, or PH is in overload, all new PS call setup messages are incremently throttled in the PH.

10.5.5.3 Protocol Handler Overload

When the PH is in overload, whether attributable to real-time or resource exhaustion, depending on the severity level of PH overload, the major actions taken by PH include:

- For a minor PH overload:

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- Delay both X.25 and internal data packets
- Deny a portion of new PS call setups (access PH)
- Activate inter-SM alternate routing
- Activate interswitch PS trunk alternate routing.

- For a major PH overload:
  - Throttle both X.25 and internal data packets
  - Deny all new PS call setups (access PS)
  - Deny inter-SM PS calls
  - Deny interswitch PS calls.

- For a critical PH overload:
  - All major overload actions and all new CS call setups are throttled.

10.5.6 USER ADMINISTRATION

During periods of overload, the subscriber may experience delays in dial tone or the call may be blocked. The overload control feature minimizes the effect of overload so that the telephone service is affected as little as possible. For exchanges with ESP enabled, subscribers designated as "essential" receive priority originating service during periods of extreme overloads. No line or trunk is permanently blocked or delayed during overloads.

The operating telephone company personnel can make requests by way of the MCC video display terminal for overload status information. The overload status information consists of a list of overload monitors and controls in effect. Whenever the overload status of a processor changes, a message is printed at the ROP and the MCC pages are updated. The MCC Page 109 indicates the status of overload conditions, if they exist, in both the AM, SM, CMP and DL, MCC Page 170 enables the administrator to request specific SM overload status. Page 109 provides the capability to request specific SM overload status and either to allow or inhibit ESP. In addition, manual input messages may also be used to request overload status information and to allow or inhibit ESP for the *5ESS*® switch.

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10.6 LINE UNIT

10.6.1 DESCRIPTION

The analog line unit (LU) is a *5ESS*® switch unit which resides in the switching module (SM) and provides connections to customer lines via the main distributing frame. The types of lines which connect to an analog LU include individual lines, party lines, coin lines, and loop or ground start private branch exchange (PBX) central office trunks. Up to 1600 ohms may be connected. (Individual and party lines may have a conductor loop resistance of up to 1500 ohms. Range extension, if necessary, is provided external to the *5ESS*® switch for LU2 and LU3. Lines which cannot be terminated on an LU are integrated services digital network (ISDN) lines, *SLC*® 96 carrier, remote terminals, and direct inward dialing PBX systems. Each LU may terminate any mix of different line types and requires 64 time slots (of the 512 time slots provided by the time slot interchanger) regardless of the concentration ratio. Each SM can accommodate up to eight LUs, although this is not normally recommended. See 235-060-110, *5ESS*® *Switch Engineering Procedures* for a detailed engineering discussion of the LU.

Each line termination on the LU has an associated line equipment number (LEN). This number is used in translations to identify the customer line and to provide a means to access the line. The LEN is composed as follows:
SM L C G S L

Where:

SMN = Switch Module Number (001-192)

L = Line Unit Number (000-007) or SM-2000 (000-042)

C = Concentrator or Grid Number LU3 (0-9) or LU2 (0-7)

G = Switch Group (Grid LU2, LU3), or Number (0-1)

S = Switch Number (0-7)

L = Switch Level Number (0-3)

The terms ``concentrator'' and ``grid'' are used synonymously throughout the various *5ESS*® switch documentation. The same is true for the terms grid (LU2 and LU3), switch group, and switch board.

One of three LU models may be used to serve customer lines. These LUs are line unit model 2 (LU2), which can accommodate up to eight concentrators, and line unit model 3 (LU3) which can accommodate up to ten concentrators.

The number of concentrators provided in any of these LUs depends on the concentration ratio desired. This is shown in Table 10.6-1 .

The number of lines that can terminate on an LU depends on the concentration ratio. A solid state concentrator (gated diode crosspoint) provides concentration ratios of 10:1, 8:1, 6:1, and 4:1. The corresponding maximum numbers of terminating lines are 640, 512, 384, and 256 per LU, respectively. This represents a maximum of 5120 lines per SM (8 LUs with 640 lines each) using LU3. Each of the four line concentration ratios has its own originating plus terminating (O+T) usage and terminal capacities. The line concentration ratio is based on a break-even hundred call seconds (CCS) per line estimate which reflects the cost benefit of additional LUs versus deloading a given line concentration ratio. Table 10.6-1 provides the line concentration capacities based on the three primary engineering methodologies. The

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reduced cost of the LU compared to the increase in line capacity does not justify the use of the 4:1 concentration ratio. Therefore, the 4:1 concentration ratio is not normally recommended.

Table 10.6-1 Line Unit Capacities Per Hour

LU2 C/R	LU3 C/R	NUMBER OF CONCEN.	TERMINALS PER C/R	O+T CCS CAPACITY	CCS/ LINE (95% FILL)	ECONOMIC BREAK EVEN CCS/LINE
EVE ONCE A MONTH (4% ORIGINATING OR TERMINATING BLOCKING)						
---	10:1	10 (0-9)	640	1,870	3.1	3.2
8:1	8:1	8 (0-7)	512	1,870	3.8	4.2
6:1	6:1	6 (0-5)	384	1,840	5.0	6.1
4:1	4:1	4 (0-3)	256	1,710	7.0	---
ABS TCBH (1.5% ORIGINATING OR TERMINATING BLOCKING) [a]						
---	10:1	10 (0-9)	640	1,700	2.8	2.9
8:1	8:1	8 (0-7)	512	1,700	3.5	3.9
6:1	6:1	6 (0-5)	384	1,650	4.5	5.5
4:1	4:1	4 (0-3)	256	1,470	6.1	---
HIGH DAY (7% ORIGINATING OR TERMINATING BLOCKING)						
---	10:1	10 (0-9)	640	1,960	3.2	3.4
8:1	8:1	8 (0-7)	512	1,960	4.1	4.4
6:1	6:1	6 (0-5)	384	1,940	5.3	6.4
4:1	4:1	4 (0-3)	256	1,840	7.5	---

Notes:

a. The CCS capacities corresponding to 1.5 percent blocking are derated by 2 percent because, on the average, the TCBH measured capacity is about 2 percent lower than the corresponding ABBH measured capacity.

Legend: C/R - Concentration Ratio LU2 - Line Unit Model 2 LU3 - Line Unit Model 3 CCS - Hundred Call Seconds O+T - Originating plus Terminating

The *5ESS*® switch can accommodate mixed concentration ratios. The choice of a particular concentration ratio depends on the usage generated by the lines. Should the office characteristics change with time, the LU can be converted to any of the other concentration ratios by changing the number of plug-ins in the LUs.

The number of LUs required for a particular office depends on the number of subscriber lines and the selected concentration ratio based upon the O+T usage per line, and the grade of service desired (i.e. % blocking criteria).

The service criteria and corresponding capacities for the LU are as follows:

- ***Average Busy Season (ABS) Time-Consistent Busy Hour (TCBH) Blocking Criteria:*** When using the ABS TCBH engineering rules, the LU capacities are stated at 1.5 percent blockage (See Table 10.6-1).
- ***High Day (HD) Blocking Criteria:*** When using the HD engineering rules, the LU capacities are stated at 7 percent (See Table 10.6-1).
- ***Extreme Value Engineering (EVE) Blocking Criteria:*** When using the EVE rules, the LU capacities are stated at 4 percent (See Table 10.6-1).

10.6.1.1 Functional Description of Line Unit

In order to properly load the LU, it may be useful to understand how the LU functions and how calls are processed through the LU. The following paragraphs provide a description of the call processing sequence as it applies to the LU, a description of the LU topology, and a discussion of how the path-hunt function is performed.

10.6.1.1.1 Typical Call Processing Description

The talk path for a typical intraoffice line-to-line call is shown in Figure 10.6-1 . When one of the lines

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served by the LU becomes active (goes off-hook), current is detected on the tip and ring leads.

A path selection process is then required in order to provide dial tone to the originating customer. When an off hook condition is recognized by the switch, a B-link is reserved and an available A-link is selected between the stage 0 switch and a stage 1 switch. Next, an available B-link is selected between the stage 1 switch and a high-level service circuit (HLSC). The HLSC is then accessed to perform the following short-job tests:

- False cross and ground test
- Power cross test
- Party test
- Coin control.

A path is then established through the time slot interchange unit (TSIU) to the universal tone generator (UTG) in the local digital service unit (LDSU) or DSU model 2 (DSU2).

The UTG generates digitally formatted dial tone and passes it to the channel circuit via TSIU. The channel circuit then converts the pulse code modulation (PCM) dial tone data to analog and sends it to the originating subscriber in the form of audible dial tone.

Next, a universal tone decoder (UTD) in the LDSU or DSU2 is connected to the originating line to receive and decode the customer dialed digits.

The customer then dials the desired telephone number, and the dialed digits are collected and translated to identify the terminating telephone. When this is completed, a path selection process is performed in the LU associated with the terminating telephone. An A-link and a B-link are selected in that LU and activated to provide a path to the terminating telephone. A UTG is then connected to the originating line, and an HLSC is connected to the terminating line to perform the following short-job tests:

- False cross and ground test
- Power cross test
- Party test
- Coin control.

Ringing current is then applied from the HLSC to the called party telephone, and audible ringing tone is returned to the calling party via the UTG.

When the called party answers, the ringing current is removed from the called party line; the UTG is removed from the calling party line, and the remainder of talk path is completed. This portion of the talk path consists of a time slot connection through the time multiplexed switch (TMS).

For administrative purposes, the talk path selection (A- and B-links) is the key to call completion since the rest of the network is virtually nonblocking. If the necessary paths are not available for any reason, then the call cannot be completed. The concentration ratio and concentrator loading are important factors to assure that the necessary A- and B-links are available.

10.6.1.1.2 Differences Between LU2 and LU3

The LU3 uses the basic building block (concentrator) from LU2. Several of the circuit packs are interchangeable between the two units. The LU3 adds two additional concentrators (8 and 9) to the existing eight (0 through 7) for LU2. The addition of the new concentrators changes the B-link random slip

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multiple. The A-links are unchanged. These two additional concentrators provide the capacity for 640 lines or a 10:1 concentration ratio (640 lines to 64 outputs). The LU3 can also be engineered to serve all of the existing concentration ratios, (4:1, 6:1, 8:1). Because of backplane wiring changes, the 10:1 ratio is only available on LU3. Because of the similarities between the two units, the administration is unchanged except for the two additional concentrators.

The LU2 and LU3 are 2-stage, limited access concentrators (see Figure 10.6-2). The LU2 is partitioned into four concentrator groups, and the LU3 has a total of five as shown in Figure 10.6-2 (sheet 2). For a 10:1 concentration ratio, the 640 lines are partitioned into 10 concentrators of 64 lines. Each group of 64 lines is served by one-half of a concentrator group (one concentrator). As shown in Figure 10.6-2 (sheet 1), a concentrator group consists of two concentrators. A concentrator consists of two switch-group circuit packs (each serving 32 lines). A switch group consists of eight stage-0 switches and four stage-1 switches. The connections between these switching stages are the A-links. The output of the stage-1 switches is the B-links which provide the connection to the service groups (Figure 10.6-2 , sheet 3).

With this type of concentrator arrangement, the 640 customer lines may be concentrated down to 64 channel circuits (using LU3 only). However, an individual line does not have access to all 64 channel circuits. Instead, each line in a switch group has a possibility of selecting one of four A-links, and each A-link may be connected to one of eight B-links. This provides a total of 32 possible paths for each customer line as shown in Figure 10.6-3 .

A fully equipped LU2 has 8 concentrators which are divided into 16 switch groups. A fully equipped LU3 has 10 concentrators divided into 20 switch groups. Figure 10.6-2 (sheet 2) illustrates the arrangement of a switch group for an LU2 and LU3 concentrator. Each switch group has 32 inputs and 32 outputs. Each of the 32 inputs are connected to a line. The 32 outputs (B-links) are multipled with the outputs of other switch groups to achieve the required concentration ratio. The switch group is composed of eight 4 by 4 first stage (stage-0) switches and four 4 by 8 second stage (stage-1) switches as shown in Figure 10.6-5 sheets 1 and 2, respectively. In Figure 10.6-5 , the 8 stage-0 switches are shown on sheet 1 and are numbered 0 through 7, from left to right. The stage-0 switch has 32 inputs and 16 outputs to provide the first stage of concentration (2:1 concentration ratio). These outputs connect to stage-1 switches and are called A-links. Each A-link is the output from two stage-0 switches and the input of one stage-1 switch (Figure 10.6-5 , sheet 2). The outputs from the switch group are multipled onto 64 paths, one to each channel circuit. These paths are the B-links.

Within the LU, there are two service groups of channel circuits with 32 circuits in each group (Figure 10.6-2 , sheet 3). These circuits perform analog to digital conversion functions. From each switch group, 16 of the outputs connect to service group 0 and 16 connect to service group 1.

Figure 10.6-6 specifies how the outputs from 16 switch groups are multipled onto the B-links through a random slip multipling arrangement. Sheet 1 of Figure 10.6-6 applies to LU2, and sheet 2 applies to LU3. This multipling arrangement provides the other point of concentration in the LU. Each row of the table represents a B-link. On each row, there are eight Xs which represent output levels that are multipled onto each B-link. For example, on B-link 0 of LU2, there are level 0 outputs on switch groups 0, 2, 4, 6, 8, 10, 12, and 14. This indicates that output level 0 on these switch groups all share B-link 0. The table produced for service group 1 is the complement of the table for service group 0. This indicates that output level 0 on switch groups 1, 3, 5, 7, 9, 11, 13, and 15 share B-link 32.

By inspecting Figures 10.6-5 and 10.6-6 more closely, the following relationships that compose the concentrator topology can be observed.

- In Figure 10.6-5 , each of the four output levels from every stage-0 switch is the input level for a different stage-1 switch. For a given line and stage-1 switch (corresponding to a B-link), there is only one A-link that can be used. For a given line and A-link, selection of a B-link is limited to those corresponding to output levels on the stage-1 switches to which the A-link is an input.

- An A-link on a switch group can be uniquely identified by its output level from a stage-0 switch and its input level on a stage-1 switch.

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- In Figure 10.6-6 (sheet 1), there are 32 Xs in each switch-group column; 16 for service group 0 and 16 for service group 1. The Xs indicate the B-links that can be reached by stage-1 switch outputs for each switch group. Four outputs from each stage-1 switch connect to one service group, and the other four outputs connect to the other service group. For any given output level (0 through 7) on LU2 and (0 through 9) on LU3, on all four stage-1 switches, two of the outputs connect to service group 0 while the other two connect to service group 1.

- The subset of B-links reached by any switch group is not the same as the subset reached by any other switch group.

The notes on Figure 10.6-6 explain how different concentration ratios are achieved. When concentrators 8 and 9 of LU3 are removed, there is an 8:1 concentration ratio as in an LU2. When concentrators 6 and 7 are removed, there is a 6:1 concentration ratio. When concentrators 4, 5, 6, and 7 are removed, there is a 4:1 concentration ratio. When a concentrator is removed, all B-links are affected equally. That is, for every concentrator removed, each B-link has one less X represented on the figure.

10.6.2 ENGINEERING CONSIDERATIONS

10.6.2.1 General

The LU concentration ratios of 10:1, 8:1, 6:1, and 4:1 are available. Each LU has a complement of 64 time slots. Table 10.6-1 presents the LU capacity under each of these concentrations for ABS, EVE, and HD.

NOTE: The capacity of the LU should be monitored as usage approaches the stated capacities. Line moves or growth procedures may be necessary to alleviate hot spots (overloads).

The LU, also referred to as the gated diode crosspoint line unit (GDX-LU), is the interface in the *5ESS*® switch that terminates switched, analog subscribers. The LU provides the coder/decoder (CODEC) function where the analog signal on the subscriber loop is converted to a digital format for passage through the switch. It is used to terminate subscribers within 18 KFT loop length, or subscribers on universal *SLC*® 96 carrier system via central office terminal (COT).

The LU is not used to terminate:

- Integrated *SLC*® 96 carrier subscribers; refer to the digital carrier line unit (DCLU) category.

- Private branch exchange-direct inward dialing (PBX-DID); refer to the trunk unit (TU) category.

- Lines requiring an integrated services line unit (ISLU); refer to the analog ISLU and ISDN.

Each LU has access to 64 time slots, one time slot set (TSS) of the switching module time slot interchanger (TSI) via two peripheral interface data buses (PIDBs). Since the LU can be equipped with grids for 256, 384, 512, or 640 line terminations, line concentration ratios (LCRs) of 4:1 (256/64), 6:1 (384/64), 8:1 (512/64), or 10:1 (640/64) result.

10.6.2.2 Coefficient of Variation

This is an optional method for time-consistent busy hour (TCBH) engineering of the LU. This method ensures that variation above or below the engineered load will not cause the office average blocking to exceed the chosen service criteria. This method also derives a specific hundred call seconds (CCS) operating point, which is used for engineering and administration, based upon the total variation in LU TCBH load in the office.

The overall goal of determining an operating point, based upon load variation, is to ensure that a particular grade of service is achieved (as defined by a chosen blocking criterion) even when high traffic variation

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increases the average blocking.

The variation in the TCBH load can be characterized by the coefficient of variation (CV) of the line unit CCS. The CV is defined as the standard deviation of the TCBH LU CCS, over all days and units, divided by the mean CCS. This total variation can also be broken down to isolate the day-to-day and the unit-to-unit variations. This allows the administrator to see how much of total variation in the office is attributable to load imbalance across LUs. Reducing the unit-to-unit variation reduces the total CV and allows the office to load more CCS per unit. While the inherent capacity of the LU is fixed, a particular office can calculate an adjusted load, referred to as an operating point, that allows the office to meet its average blocking objective, given the amount of load variation present.

To derive the values for the CV inputs, the engineer must analyze current office LU data to determine the exact CV. For initial offices, it is necessary to analyze data from a similar office to determine the approximate CV.

Good administrative practices, including proper load administration, lowers the unit-to-unit variation, and thus the total office variation. This allows more efficient utilization of the LUs by allowing higher CCS to be loaded without increasing the average blocking of the office. Present methods for taking into account variation in TCBH load provides a mechanism to protect the average blocking. However, it protects service during peak periods only indirectly. Direct protection of service during peak periods can still be achieved only by using either HD or extreme value engineering (EVE).

10.6.2.2.1 Characterizing Load Variation

The overall goal of determining an operating point, based upon load variation, is to ensure that a particular grade of service is achieved even when high traffic variation increases the average blocking.

The variation in the TCBH load can be characterized by the CV of the LU CCS. The CV is defined as the standard deviation of the TCBH LU CCS, over all days and units, divided by the mean CCS. This total variation can also be broken down to isolate the day-to-day and the unit-to-unit variation. This flexibility allows the administrator to see how much of the office total variation is attributable to load imbalance across LU. Reducing the unit-to-unit variation reduces the total CV and allows the office to load more CCS per unit.

10.6.2.2.2 Determining the Coefficient of Variation

The following equations are required for determining an office CV:

Total CV □ Exact:

Unit-to-Unit CV:

Day-to-Day CV:

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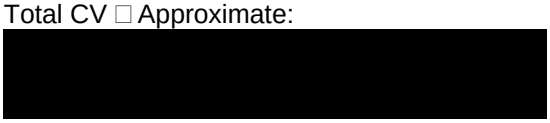
Total CV □ Approximate:



For existing *5ESS*® switches, Equation 1 directly calculates the total coefficient of variation from office data. Equations 2 and 3 compute the marginal variations across days and units. These CVs are defined to be comparable so that one can observe which contributes most to the total CV when a complete set of *5ESS*® switch data is not available. The total CV typically ranges between 6 and 15 percent.

10.6.2.2.3 Existing *5ESS*® Switches

Offices with existing switches should use Equation 1 to calculate the CV directly from the hourly TCBH data. This equation calculates the CV according to the definition stated in the previous paragraph.

10.6.2.2.4 New Starts and Conversions

New offices or offices converting from other switching systems should use Equations 2 through 4 to estimate the expected CV. These equations allow a new *5ESS*® switch to be engineered using available traffic data and administrative goals to calculate the total CV.

10.6.2.2.4.1 Unit-to-Unit CV (CV_U)

The CV_U should be determined based upon measured variation in other *5ESS*® switches having similar traffic and feature mixes. CV_U can be seen as the variation goal to which the office will be administered. The CV_U should range from 6 to 7 percent in offices administered by class of service. Offices using load-directed assignments practices should see a unit-to-unit variation from 2.5 to 3 percent.

10.6.2.2.4.2 Day-to-Day CV (CV_D)

If an existing switch is being converted to a *5ESS*® switch, the day-to-day CV can be determined from traffic data from the old system. Since CV_D is defined to be independent of the unit variation, it can be calculated on any switch regardless of the size or number of LUs and be used for engineering the switch. New offices should estimate CV_D based upon other *5ESS*® switches with similar traffic characteristics. Day-to-day variation has been observed to range from 3 to 9 percent.

10.6.2.2.4.3 Interaction Term (R)

Since CV_U and CV_D have been defined to be independent, there is a third source of variation which is caused by the interaction between the two dimensions in the CCS data matrix. This interaction between unit-to-unit and day-to-day variation is captured in a third term, which is identified as "R" in Equation 4. The R has been observed to vary from 3 to 8 percent and tends to average around 6 percent. This variation can also be estimated using variation data from offices with similar unit-to-unit and day-to-day variations. This is done by working Equation 4 in reverse:

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10.6.2.2.5 Determining the LU Operating Point

While the inherent capacity of the LU is fixed, a particular office can calculate an adjusted load, referred to as an Operating Point, which allows the office to meet its average blocking objective, given the amount of load variation present. Tables 10.6-2 through 10.6-4 provide the CCS operating point based upon three inputs:

(1) Blocking criteria

(2) LU concentration ratio

(3) Coefficient of variation.

Table 10.6-2 CCS Operating Point for 4:1 Line Units

CV	PERCENT BLOCKING				
	0.5	1.0	1.5	2.0	3.0
.04	1250	1405	1490	1555	1645
.05	1245	1400	1490	1550	1640
.06	1245	1395	1480	1545	1635
.07	1240	1390	1475	1540	1625
.08	1235	1385	1470	1530	1615
.09	1230	1375	1460	1525	1610
.10	1220	1370	1455	1515	1600
.11	1215	1360	1445	1505	1585
.12	1210	1350	1435	1495	1575
.13	1200	1340	1425	1480	1565
.14	1195	1330	1410	1470	1550
.15	1185	1320	1400	1460	1535
.16	1175	1310	1390	1445	1520
.17	1165	1300	1375	1430	1510
.18	1160	1290	1365	1420	1495
.19	1150	1280	1350	1405	1480
.20	1140	1265	1340	1390	1465

Table 10.6-3 CCS Operating Point for 6:1 Line Units

CV	PERCENT BLOCKING				
	0.5	1.0	1.5	2.0	3.0
.04	1485	1600	1665	1715	1780
.05	1480	1590	1660	1710	1770
.06	1470	1585	1650	1700	1760
.07	1465	1575	1640	1690	1750
.08	1455	1565	1630	1675	1735
.09	1445	1550	1615	1665	1725
.10	1435	1540	1605	1650	1710
.11	1420	1525	1590	1635	1690
.12	1410	1510	1575	1620	1675
.13	1395	1495	1560	1600	1655
.14	1385	1480	1540	1585	1640
.15	1370	1465	1525	1565	1620
.16	1355	1450	1505	1545	1600
.17	1340	1435	1490	1530	1580
.18	1325	1415	1470	1510	1560
.19	1310	1400	1455	1490	1540
.20	1295	1380	1435	1470	1520

Table 10.6-4 CCS Operating Point for 8:1 and 10:1 Line Units

CV	PERCENT BLOCKING				
	0.5	1.0	1.5	2.0	3.0
.04	1560	1660	1720	1760	1815
.05	1555	1650	1710	1750	1805
.06	1545	1640	1700	1740	1795
.07	1535	1630	1690	1725	1780
.08	1525	1620	1675	1710	1765
.09	1510	1605	1660	1695	1750
.10	1500	1590	1645	1680	1735
.11	1485	1575	1625	1660	1715

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.12	1470	1555	1610	1645	1695
.13	1455	1540	1590	1625	1675
.14	1435	1520	1570	1605	1655
.15	1420	1500	1550	1585	1630
.16	1405	1485	1530	1560	1610
.17	1385	1465	1510	1540	1585
.18	1370	1445	1490	1520	1565
.19	1350	1425	1470	1500	1545
.20	1335	1405	1450	1480	1520

The blocking criteria included are those supported in *5ESS*® Switch Digital Ordering and Planning System Module (DOPSMOD) and are reasonable for ABS engineering. An explanation for the equation underlying these tables follows. Note that the values for C and K are based on the load service curve for the appropriate concentration ratios. Equations for these curves and a discussion of their use in deriving the Operating Point tables are provided.

The LU Operating Point (OP) is defined as: OP = C - K □ (Mean CCS □ CV)^2 Where:

- □ C is the CCS capacity from the appropriate load service curve based on the blocking criterion chosen.
- □ K is a constant derived from the appropriate load service curve, given the following:

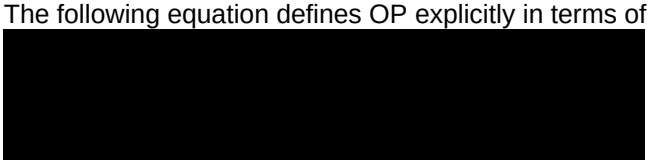
Concentration	K
4:1	.00224
6:1	.00298
8:1,10:1	.00340

- □ Mean CCS is the average TCBH load over all LUs and days.
- □ CV is the Coefficient of Variation as described in the previous section.

Since the office LUs will be engineered according to the calculated OP, it is assumed that each LU will eventually be loaded to the OP. Thus in the previous equation, OP can be set equal to Mean CCS:

OP = C - K □ (OP □ CV)^2

The following equation defines OP explicitly in terms of C, K, and CV.



An important observation is that using the 1.5 percent blocking criteria, for 6:1, 8:1, and 10:1 LUs, if the CV is 6 percent or less, the operating point equals or exceeds the current advertised capacity. For 4:1 LUs this relationship is true if the variation is 8 percent or less.

10.6.2.2.6 Load Service Curves and Derivation of CCS Operating Points

Tables 10.6-2 , 10.6-3 , and 10.6-4 contain CCS operating points based on the LU capacities associated with the historic Lucent load-service curves. These curves were generated by simulation models and verified by field data. These curves show percent blocking as a function of the CCS load per hour. As CCS traffic on the LU increases, percent blocking also increases. This blocking behavior depends on the LCR of the LU being considered. The following equations approximate these curves by defining the percent blocking (B) as a function of CCS load per hour (C), or alternately, by defining CCS load (C) as a function of blocking (B). Figure 10.6-4 illustrates the percentage of terminating blockage as a function of usage.

4:1 LCR:

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or

6:1 LCR:

or

8:1/10:1 LCR:

or

In the paragraph ``Determining the LU Operating Point,'' the letter C represents the LU capacity for a particular blocking criteria, as defined in the previous equations. The value of C is the capacity with no load variation, that is, CV equals 0. It is these capacities which are used as the basis for determining the operating points in Tables 10.6-2 , 10.6-3 , and 10.6-4 .

10.6.2.2.7 Selection of Line Concentration Ratio

In general, a determination of the LCR is required based upon the economics of different concentration ratios. The DOPSMOD historically has provided economic breakpoints between concentration ratios, based on CCS per line. The engineer should generally perform the LU engineering using the indicated Line Concentration Ratio (LCR), and if the CCS per line is near a breakpoint, then engineer for the LCR on the other side of the breakpoint. These breakpoints are based upon hardware costs only and do not take into account software right-to-use fees per SM.

Tables 10.6-5 , 10.6-6 , and 10.6-7 show the break points given that a CV and the percent blocking have been selected. These tables should be used as general guidelines for selecting the LCR. These values were determined by dividing the current break point for each blocking criteria by the LU capacity and multiplying by the CCS OP corresponding to the selected variation and blocking.

Table 10.6-5 Economic Breakpoints for CVE 4:1 vs 6:1 LCR

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CV	PERCENT BLOCKING				
	.5	1.0	1.5	2.0	3.0
.04	4.95	5.27	5.50	5.64	5.87
.05	4.93	5.24	5.48	5.62	5.84
.06	4.90	5.22	5.45	5.59	5.80
.07	4.88	5.19	5.42	5.56	5.77
.08	4.85	5.16	5.38	5.51	5.72
.09	4.82	5.11	5.33	5.48	5.69
.10	4.78	5.07	5.30	5.43	5.64
.11	4.73	5.02	5.25	5.38	5.57
.12	4.70	4.97	5.20	5.33	5.52
.13	4.65	4.92	5.15	5.26	5.46
.14	4.62	4.88	5.09	5.21	5.41
.15	4.57	4.83	5.04	5.15	5.34
.16	4.52	4.78	4.97	5.08	5.28
.17	4.47	4.73	4.92	5.03	5.21
.18	4.42	4.66	4.86	4.97	5.14
.19	4.37	4.61	4.81	4.90	5.08
.20	4.32	4.55	4.74	4.83	5.01

Table 10.6-6 Economic Breakpoints for CVE 6:1 vs 8:1 LCR

CV	PERCENT BLOCKING				
	.5	1.0	1.5	2.0	3.0
.04	3.51	3.74	3.90	3.95	4.07
.05	3.50	3.71	3.87	3.92	4.05
.06	3.48	3.69	3.85	3.90	4.03
.07	3.45	3.67	3.83	3.87	3.99
.08	3.43	3.65	3.79	3.83	3.96
.09	3.40	3.61	3.76	3.80	3.93
.10	3.37	3.58	3.73	3.77	3.89
.11	3.34	3.54	3.68	3.72	3.85
.12	3.31	3.50	3.65	3.69	3.80
.13	3.27	3.47	3.60	3.64	3.76
.14	3.23	3.42	3.56	3.60	3.71
.15	3.19	3.38	3.51	3.55	3.66
.16	3.16	3.34	3.47	3.50	3.61
.17	3.12	3.30	3.42	3.45	3.56
.18	3.08	3.25	3.37	3.41	3.51
.19	3.04	3.21	3.33	3.36	3.47
.20	3.00	3.16	3.28	3.32	3.41

Table 10.6-7 Economic Breakpoints for CVE 8:1 vs 10:1 LCR

CV	PERCENT BLOCKING					
	.5	1.0	1.5	2.0	3.0	4.0
.04	2.68	2.84	2.95	3.02	3.11	3.19
.05	2.67	2.82	2.94	3.01	3.09	3.18
.06	2.66	2.80	2.92	2.99	3.07	3.16
.07	2.64	2.78	2.90	2.96	3.05	3.13
.08	2.62	2.77	2.88	2.94	3.02	3.10
.09	2.60	2.74	2.85	2.91	3.00	3.07
.10	2.58	2.72	2.83	2.89	2.97	3.04
.11	2.56	2.69	2.79	2.85	2.94	3.01
.12	2.53	2.66	2.77	2.83	2.90	2.97
.13	2.50	2.63	2.73	2.79	2.87	2.94
.14	2.47	2.60	2.70	2.76	2.83	2.90
.15	2.44	2.56	2.66	2.72	2.79	2.86
.16	2.41	2.54	2.63	2.68	2.76	2.82
.17	2.38	2.50	2.59	2.65	2.71	2.78
.18	2.35	2.47	2.56	2.61	2.68	2.74
.19	2.32	2.43	2.52	2.58	2.65	2.70
.20	2.29	2.40	2.49	2.54	2.60	2.66

10.6.2.2.7.1 Recommendations for Communities of Interest

A community is a group of jointly administered LUs having common traffic characteristics. As a result, they should be considered together for engineering purposes. The method discussed for determining an OP should not be used on an office-wide basis where multiple communities are known to exist.

For instance, when determining an office CV, RSM and ORMs should not be included. This approach is

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compatible with current engineering procedures because DOPSMOD engineering for RSMs and ORMs is performed separately from the host office.

10.6.2.2.7.2 Recommendations for High Day

Offices currently using HD engineering can continue to do so. Some offices which were not previously HD limited may become so if the calculated operating point is greater than the current LU capacity. Conversely, if the operating point is lower than the current LU capacity, the office which was previously HD limited may no longer be so.

10.6.3 ASSIGNMENT GUIDELINES

10.6.3.1 General Description

The analog LU provides two limited resources: lines (terminations) and traffic capacity (usage measured in CCS). The number of line units engineered per office is based on the average CCS per line, concentration ratio, terminations, and CCS capacity of the line unit. Once the CCS/line is determined, the concentration ratio is selected which has a fixed line termination and traffic capacity values. For the LU, the usage determines which resources are expected to exhaust first.

For a better understanding of the limiting resource, the following examples show how assignment of lines may impact the utilization of engineered line equipment and CCS capacity. Our examples will use an 8:1 concentration ratio LU, with a line capacity of 512 lines and a traffic capacity 1,700 CCS ABS.

(1) If the average CCS per line is less than 3.32 (1,700 CCS/512 = 3.32 CCS per line), the line capacity will be reached before the usage capacity. This example shows 100% line termination and CCS capacity utilization.

(2) If the CCS per line is greater than 3.32, the reverse is true. For example, at 3.9 CCS per line, each LU can serve 435 working lines (1,700 CCS/3.9 CCS per line = 435 lines). This example shows 100% CCS capacity and 85% line termination utilization.

The first assignment objective in the preceding example is obvious: assignment rules should limit line assignments to 1,700 CCS per LU.

The second objective is more obscure: in order to achieve the average lines per unit, the assignments must be based on the assumption that the traffic is uniform. In practical terms, this means that all LUs will look roughly alike in terms of mixtures of high and low usage lines, and will reflect the mixture of the office.

The importance of the second objective can be made clearer by an illustration (although an admittedly unrealistic one) based on the numbers used in the preceding example.

Consider a LU2 office engineered for 870 installed lines operating at the 3.9 CCS per line of the example. Assume, also, that 100 of the lines are high usage (data terminals, for example) operating at an average 18 CCS per line. Notice the impact on line termination capacity by assignment of the high CCS lines in one LU.

(1) The arbitrary assignment of these high usage lines to one of the installed LUs will exhaust the traffic capacity of that unit at 94 lines (1,700 CCS/18 CCS per line = 94 lines). This LU has terminations that are trapped (unusable) due to exhausted CCS capacity.

(2) The attempted assignment of remaining lines to the second LU creates a "trapped CCS capacity" situation due to the much lower average CCS of the remaining lines. This means that the 512 terminations in this LU are exhausted before the 1,700 CCS capacity of the LU is reached. Further, there are a total of 870 lines to be assigned and the office has suffered a loss of 264 lines of capacity (870 - 512 - 94 = 264). This loss occurred even though the first assignment objective was met.

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Thus, for the preceding example, the assignment guidelines are:

(1) Limit assignments to 1,700 CCS per unit.

(2) Since the CCS/line is 3.9 (1700/3.9), the average assignments to 435 (870 lines/2 LUs = 435) lines per unit.

(3) Maintain a uniform mix of lines over all LUs in order to achieve 1 and 2.

If these guidelines are followed, the full engineered CCS and line termination capacity can be achieved.

Within each switch group, lines should be assigned by class of service (or expected load) to the stage-0 switches in the following order:

SWITCH 0 - 1 - 4 - 5 - 2 - 3 - 6 - 7 - 0 - 1, etc.

As line assignment begins on the switch group, no competition for A-links is realized until an assignment is made for switch 2. This assignment and all subsequent assignments cause competition for A-links. This can also be seen in Figure 10.6-5 .

This sequence spreads the load evenly across the A-links as shown in Figure 10.6-5 .

On initial and growth cutover jobs, class of service balancing should be used while assigning lines to LUs. While assigning lines from a given class, business for example, first assign lines to SMs; within an SM across the LUs in the SM; within an LU across two switch groups; and within a switch group across the eight switches. The order to be used while assigning lines across eight switches is as shown previously.

NOTE: It is not necessary to limit the number of SMs to spread IDP (Centrex) and MLHGs. It is still necessary to spread lines over Line Units, concentrators, Switch Groups, Switches, and Levels.

An exception to this procedure is the lines for any customer group sharing the business and residence custom services (BRCS) individualized dialing plan (IDP). The lines of such a group are the same class of service (business) but should be assigned to only a few SMs in the office to avoid unnecessary data duplication, and also to maintain satisfactory recent change and time of day response times. However, within the SM, these lines are assigned according to the previously described guidelines. For further information, refer to "Memory Implications" elsewhere in this section and to 235-190-101 - *Business and Residence Modular Features.*

Essential service lines (fire and police department, operating rooms, switching offices, coin lines, etc.) are assigned in the same manner with no more than one line assigned to a switch. Since an office is not expected to have more than 25 percent essential service lines, the preceding procedure automatically ensures that no more than one essential line is assigned to any switch.

Overloads due to improper load distribution in the SM are avoided by balancing the loads in the LUs. The *5ESS*® switch does not employ junctors; therefore, it is not required that the loads be equal. The load is spread across the LUs by CCS per class of service to maximize the use of terminals. If the load approaches or exceeds capacity on the channel circuits or B-links, customers may experience dial tone delay or blockage.

It is important to avoid overloading individual LUs in the *5ESS*® switch. This can be done through usage-directed line assignments. Initially, line assignments should be distributed as uniformly as possible according to class of service. After cutover, reassignments may be made according to measured usage. New line assignments should be made to the LUs with the lightest loads. To avoid stranding capacity, termination fill and class of service should be considered. Lines with high-usage classes of service (PBX and business lines for daytime busy hours and residence lines for evening busy hours) should be

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assigned to LUs with relatively low termination fill.

10.6.3.2 Initial Loading Guidelines

To load analog lines in an LU, the switch administrator must consider classes of service, loading groups, switches, and levels.

- Class of service - Lines with similar calling characteristics.
- Loading group - One or more LUs into which a group of line classes is to be loaded using a single concentration ratio. A loading group is the number of switch groups in the LUs of a single concentration. One 8:1 LU contains 16 switch groups. A growth of 7 LUs at 8:1 concentration provides 112 switch groups or 3,584 maximum line terminations.
- Switch group - Eight switches, each of which contains four levels. Each switch group contains 32 lines.

Special loading is not necessary, if all lines in the loading group have the same average CCS per line. Prior to assignment on the switch, it is recommended to perform a CCS per class of service study in the Busy Season before cutover. The CCS per class of service study data should be utilized in the creation of the loading pattern. Also, when using an operational support system for assignment, update the CCS values in the system.

NOTE: However, a loading pattern is necessary when there are wide differences in the average CCS per line class code.

Figure 10.6-5 (sheet 1) illustrates a single switch group within the LU. Each switch group has 32 terminations that are divided into a switch and level. The loading sequence indicates the proper load pattern needed to administer an LU.

Notice that the load pattern is broken into switch pairs, that is, 1,2,3,4. This results in a switch order of 0,1,4,5,2,3,6,7. This pattern ensures that the high CCS line classes have maximum accessibility through the A-link.

Create a loading pattern assigning high CCS line classes to switch 0 level across the office, then proceed to switch 1 level 0, etc. When using an operational support system for assignment, verify the assignment algorithm is consistent with the switch order of 0,1,4,5,2,3,6,7.

For example, assume you are loading two line classes □ 16 lines with high CCS and 16 lines with low CCS. If you load the 16 high CCS lines first in a conventional manner of switch 0, level 0 through to switch 3, level 3 and all 16 links go off-hook simultaneously, 4 lines would be denied access to an A-link (specifically, A-Links 1,3,9,11). By loading in the recommended switch sequence of 0,1,4,5,2,3,6,7, all lines have access to an A-link.

NOTE: To minimize blocking of calls, loading must be done in a specific pattern. Since dialing habits vary for different line classes, the loading pattern should create a mix of classes within any one switch group. The purpose of the loading pattern is to make sure that all switch groups look alike to utilize the equipment more efficiently and at the same time minimize blocking.

10.6.3.2.1 Loading Requirements

Listed below are the recommended steps needed for the administrator to assign lines. Note that this information also helps the equipment engineer decide what concentration ratio is needed for the office:

- First the number of switch groups in the loading group must be determined. For example, if an office is experiencing a growth job of seven 8:1 LUs, then there will be 16 = 112 switch groups. See Figure 10.6-2 (sheet 2). IDS See Figure 10.6-2 . This figure shows two switch groups for every

concentrator: 8:1 concentration requires 16 switch groups (SWGs), 6:1 concentration requires 12 SWGs, and 4:1 concentration requires 8 SWGs.

- The next step is to determine the number of end-of-period (EOP) lines in the loading group. Since the forecasting and planning engineers have generated this information before ordering the LUs, the administrator needs to know this information to be sure that the EOP terminations are not exceeded when assigning lines.
- Identify and prioritize the class of service to be included in each loading group by determining the average CCS/main station (MS) for each class of service. For example:
  - Business CCS/MS = 4 (***Note:*** Assignment to centrex lines is limited by memory and therefore should be assigned within a certain number of SMs.)
  - Residence CCS/MS = 2
- Arrange class of service in order of priority (highest CCS/MS = first priority).
- Before loading the loading group, the number of EOP lines for each class of service must be determined. Depending on the growth of the office, it is very important to know how much equipment utilization will be used up at the EOP study to be prepared for future growth.
- Determine the administrative spare factor. If used, the equipment will have space available for things like unforeseen growth for each particular class of lines. Also, allowances should be made for inward and outward movement of main stations and spare terminals to permit rearrangement for loading purposes.
- Now the administrator is ready to fill out the loading priorities worksheet, Parts 1 and 2 (Figure 10.6-7 , sheets 1 and 2) which run through each step mentioned previously.
- After Parts 1 and 2 are completed, this information is used to complete the worksheet, Part 3 (Figure 10.6-7 , sheet 3). Part 3 determines where a line will go in the loading group.
- Follow the numbered steps on the worksheet. First priority line class code (such as MLHG) uses steps 1 and 2. The remaining assignments use steps 3 through 7. When assigning the first and remaining prioritized line class codes, enter the information in the table on sheet 4 of Figure 10.6-7 after completing steps 2 and 7.
- Under the column ASSIGNMENT in row 1 will be the amount of available lines in switch 0, level 0 of the loading group. This number has already been determined from Column F in Part 2 (Figure 10.6-7 , sheet 2) of these worksheets.
- After completing step 2 of Part 3 (Figure 10.6-7 , sheet 3), enter the information in the table shown on sheet 4 of Figure 10.6-7 . After step 2, take the number of lines for one line class code and assign the lines to switch 0, level 0 in all LUs until the limit is reached from Column F. Next, assign the rest of the lines to switch 1, level 0. If additional lines remain, begin assigning lines to switch 4, level 0. If there are no more lines and more lines can be assigned to switch 1, level 0, then fill this row with the next class of service.
- The "Whole Number" in steps 1 and 6 indicate how many full rows are assigned to a particular line class code, and steps 2 and 7 indicate how many partial assignments a row should have for the same particular line class code.

10.6.3.2.2 Maintaining LU Load Balance

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NOTE: When loading is completed, monitor the office closely for changes in the growth pattern or increased CCS/network access lines (NAL) and ensure the load is spread over all the LUs. A good class of service spread provides better use of the equipment and better customer service.

Existing office loading patterns should be reviewed, as necessary, to maintain the integrity of the loading pattern. As new classes of service are established, estimate the expected CCS, then do a study to validate the average CCS Generated. Each office is unique and should not be duplicated. Verify the operational support system assignment algorithm used for assignment of series hunt, MLHG, and Centrex.

The following key indicators are important to ensure that the LUs remain in proper balance. This list contains key items to monitor after loading the LU:

- Check for dial tone delay (TRFC30 Section 4) and terminating blockage (TRFC30 Section 11). Log the terminating blockage and dial tone speed delay to identify if blockage is occurring. Dial tone delay and terminating blockage are reduced when a good class of service balance is achieved.

  The LU2 is a 2-stage, limited access concentrator. Blockage may occur at either the A- or B-link. Two types of link blockage can occur. First, the four A-links that are accessible by any one line can be busy. Secondly, if an A-link is available for the line, the B-links (which are multipled to four, six, eight, or ten switch groups, depending on the LU concentration ratio) may not be accessible by the selected A-link. To avoid this situation, it is important to ensure that the LU is not overloaded. Furthermore, the total CCS load should be distributed as evenly as possible across all LUs to minimize unit-to-unit variation. Keeping the loads on all LUs having the same traffic capacity within a reasonable range is sufficient to avoid this type of service blockage. If A- and B-link blockages do occur, collect measurements on a switch group basis (TRFC30 Section 144) to more precisely isolate the problem.

  The switch administrator should monitor the LU (TRFC30 Sections 11 and 144) data to ensure that the LUs are not loaded over the desired capacity level. Daily busy-hour measurements can be compiled to monitor the load balance.

- For problems with high dial tone delay and low terminating blocking, check the occupancy of the switch module processors (SMPs). Half-hour occupancy readings higher than 70 percent (TRFC30 Section 13) for the SMP may mean that the SMP is being overloaded under peak calling conditions. Such overloads may produce customer complaints of terminating blocking and slow dial tone.

  Also, check the TRFC30 reports for out of service (maintenance usage) equipment which may cause line origination problems. For more information on dial tone delay, SM occupancy, and out-of-service equipment, review the read-only printer printouts and the OMS5E reports, if they are available from the SCC. These reports provide information about SM status and other vital information relating to the LU.

- If assignment systems such as Computer System for Main frame Operations (COSMOS) are used, ensure that the CCS/class of service parameters that provide load-directed assignments accurately reflect customer calling usage. This can be done by performing CCS per class of service studies.

- Inhibit new assignments into the SMs with consistently high CCS, dial tone delay, and terminating blockage.

- If EADAS data is available, review the CCS values from the LU EVE report. This report provides the highest CCS reading obtained per LU for a 24-hour period and can be used to validate the busy hour of the office compared to the busy hour of the LU. This information can also be used for time of day balancing. For example, one LU may be used heavily at 7 PM only. As a result, it would be efficient to assign new business customers with a busy hour of 11 AM to this LU.

- To ensure that one LU is not used constantly for assignment thus causing it to overload or block consistently, update the USAGE status for each LU into the line assignment system. Traffic 30 Section 11 provides a total LU usage report.

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- Check the spread of heavy-usage customers in LUs that are having troubles with blockage or exceeding the LU capacity. How many MLHGs are assigned in the LUs? Are the MLHG terminals spread within all the LUs in the SMs? Identify all MLHGs and other heavy-usage lines within a troubled LU.

- Do not assign consecutive MLHG terminals in the same LU (that is, terminal 1, terminal 2). Unless the MLHG is a uniform call distribution (UCD) group, terminal 1 will generate the heaviest usage, then terminal 2, etc. Always assign a good mix of terminals within the LUs. This principle should be applied to series line hunts, heavy usage lines, and centrex customers also.

- If there are problems with LUs containing MLHGs, busy studies should be set up on each MLHG to determine if group overflows are occurring. If so, more lines may be required in those groups.

- Identify the LUs with the highest usage CCS/NAL. This is done by either of two methods. Either process identifies the LUs with heavy and light usage and where lost capacity can be regained:

  - Take the total busy hour CCS/LU (TRFC30 Section 11) divided by the number of working network access lines in the LU; For an 8:1 concentration ratio, the CCS/MS should not exceed 3.9 ABS TCBH. compare this with the CCS/main station break point chart.

  - Plot individual LU on a graph, using LU busy hour CCS (TRFC30 Section 11) and working network access lines.

- The LU concentrator utilization measurements (LUCUM) may be used to identify high usage customers. Activate LUCUM on both high and low usage LUs to move high usage lines from one LU to a low usage LU. For more information on the activation and the limitations of LUCUM and BCI, see *Engineering and Administrative Considerations.*

- *The blocked call indicator (BCI) feature can also be used to determine which LU needs the LUCUM feature activated. For more information on the activation and the limitations of LUCUM and BCI, seeEngineering and Administrative Considerations.*

- *The LU/ISLU Load Administration Measurements feature can be used to monitor LU half grids or service groups. Section 144 of TRFC30 provides usage counts based on a 100 second scan for each switch group for up to 4,000 switch groups. This measurement allows the administrator to perform load administration of the LUs. For more information on the activation and the limitations of Section 144, seeEngineering and Administrative Considerations.*

To use TRFC30 Section 144 for load balancing:

Set up weekly studies using TRFC30 Section 144 during the busy hour for each day of the week or collect half hour data all week to validate the busy hour for all the LUs in the office or for a portion of the LUs (no more than 4,000 switch groups can be studied at a time). Analyze the Section 144 data using one of the following balancing processes:

(1) For offices with 8:1 concentration ratios, each switch group in the office or the study group should be balanced to average 53 CCS (1700 CCS (8:1 MAX ABS TCBH)/2 = 850 CCS; 850 CCS (30 Min)/16 (switch groups) = 53.125 CCS. Assign lines to switch groups that average under 53 CCS and stop assignments to switch groups that average 53 CCS. If the switch group is averaging above 53 CCS, deload the switch group or use the following balancing process.

(2) Within one 8:1 LU, the average of the 16 switch groups can equal 53 CCS, and this implies that some switch groups will be greater than 53 CCS, at the same time others will be less. This process may be harder to track because the value of each switch group in one LU will be different.

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Table 10.6-8 indicates the switch group average CCS capacity (30 Min) for each engineered LU capacity.

Table 10.6-8 LU Switch Group Average Capacity (Section 144)

NO. OF SWITCH GROUPS	LU CONC. RATIO	4% EVE		1.5% ABS TCBH		7% HD	
		LU CAP (30 MIN) CCS	SWITCH GROUP AVG. CCS	LU CAP (30 MIN) CCS	SWITCH GROUP AVG. CCS	LU CAP (30 MIN) CCS	SWITCH GROUP AVG. CCS
20	10:1	935	46.75	850	42.50	980	49.00
16	8:1	935	58.43	850	53.12	980	61.25
12	6:1	920	76.66	825	68.75	970	80.83
8	4:1	855	106.87	735	91.87	920	115.00

Section 144 is output to the EADAS channel. Once Section 144 is activated, raw traffic data on usage is sent directly to EADAS, when requested, every 30 minutes. From EADAS, only selected data is sent to other downstream processors for load balancing. Table 10.6-8 should be used for setting thresholds for exception reports for EADAS and capacity for line assignment systems at the switch group level.

10.6.3.3 Memory Implications

NOTE: It is not necessary to restrict assignment of IDP (Centrex) and MLHGs lines to a specified number of SMs. It is still necessary to spread lines over Line Units, Concentrators, Switch Groups, Switch, and Levels.

In the *5ESS*® switch, data common to groups of lines, specifically BRCS IDP groups, is stored in the SMs. This data is stored whenever one or more lines of the group are served by that SM. This requires some effort to assign lines such that groups are not spread uniformly to all SMs. Uniform assignment of lines results in excessive duplication of data. This, in turn, results in poor use of SM memory and some minor degradation in recent change response time.

Lines for any customer group sharing the BRCS IDP are assigned in a different manner than other lines. The lines of such a customer group are of the same class (business), but should be assigned to only a few SMs in the office in order to avoid unnecessary data duplication, and also to maintain satisfactory recent change and time-of-day change response times. However, within an SM, the lines should be assigned in the same manner as other lines. Assigning IDP lines in this manner avoids data duplication and maintains satisfactory response times for abbreviated dialing plans, automatic route selection (ARS) routing patterns, private facility access (PFA) data, and measurements.

Private facilities (for example, tie trunks, and foreign exchange lines) provided for a BRCS customer group require access to common data. As a result, IDP data must reside in each SM that terminates BRCS private facilities. The IDP data must be loaded into an SM with BRCS private facilities even if no BRCS IDP lines terminate on that SM.

The number of SMs to which a BRCS IDP group is assigned depends on the size of the group. The guidelines shown in Table 10.6-9 may be used. These guidelines assume an equal balance of LUs across the SMs.

Table 10.6-9 BRCS Group Assignment

GROUP SIZE	SMs
Less than 10	2
10 to 25	3
25 to 50	4
50 to 100	6
100 to 200	10
200 to 500	12
500 to 1,000	15

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More than 1,000	20 or more

As an example, suppose a customer group that shares a BRCS IDP has 30 lines. Then, according to Table 10.6-9 , these lines should be assigned to four SMs in the office. Procedures for assigning other types of lines would require these lines to be spread across as many as 30 SMs in the office. These guidelines may be altered based on the number of SMs available in a particular office. Table 10.6-9 describes how a specific BRCS group should be assigned. In general, BRCS customers should be spread across the entire office.

10.6.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

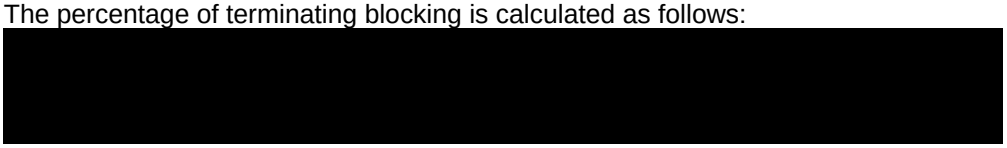
Sections 4, 11, and 144 of the TRFC30 report provide data for monitoring the LU usage. Additionally, the EADAS EVE report provides usage and busy-hour identifications. This data may be collected periodically (daily, weekly, etc.) and evaluated to determine if corrective actions are required. Initially, the corrective actions may consist of directed assignments or collection of disconnects. These actions should be based on the LU percent of capacity or the number of terminating blocked calls. The LUs with high call blocking or nearing capacity should be checked for high maintenance usage on the A-links and B-links, usage exceeding LU capacity, and administration rebalance.

10.6.4.1 Terminating Blocking

Traditionally, matching loss is used as a measure of customer attempts that do not complete because the switching machine cannot provide a talking and/or service path. For this measurement to be pegged, the called line must be idle and a service circuit must be available.

The matching loss indicator is not employed in the *5ESS*® switch because the only significant network blocking in the entire *5ESS*® switch occurs in the LU. Instead, a percentage of terminating blocking indicator is used. (See TRFC30 Section 11.) This indicator is based on the count of terminating calls which fail to complete because of A- or B-link unavailability. The measurement is made for each LU. This indicator is well suited since the LU capacity is far less than that of the TSI-TMS network which makes the LU the limiting unit. Additionally, terminating calls are given priority to originating calls because terminating calls, which are nearly completed, have used more resources than originating calls.

The percentage of terminating blocking is calculated as follows:



Where:
TMBLK = Terminating Blocking Peg Count

TMCALL = Terminating Call Peg Count

The terminating blocking peg count is registered when an unsuccessful attempt is made to seize an A- or B-link because none are available. The terminating blocking measurements are found in section 11 of the TRFC30 report. The LUs should be investigated when terminating blockage exceeds the percent grade of service established for your office.

If terminating blocking occurs, the maintenance usage of the particular LU should be checked. If maintenance usage is not a factor, then the capacity or administration of the LU should be checked. If the LU is at or near capacity and causing the service degradation, the LU should be monitored closely. The appropriate response depends on factors such as expected growth and the length of time until the busy season. Severe overloading may require deloading of the LU.

The LUCUM report provides the ability to request traffic measurements on individual concentrators to

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determine where blocking is occurring. These measurements can be used to determine which lines are being affected and how the load may be redistributed to alleviate the situation. These measurements may be obtained for up to 20 switch groups at a time (640 lines). These measurements are found in section 90 of the TRFC30 report and may be allowed or inhibited as necessary. Included in these measurements are: total originating and terminating attempts, total originating and terminating blockages, and total usage. For additional information concerning LUCUM see the section on *Engineering and Administrative Considerations*.

The blocked call indication (BCI) report provides an indication of originating and terminating network blockage. It is similar to the LENO1 feature of the 1A *ESS*™ switch. These reports, provided as an output message on the ROP, indicate which lines are experiencing A- or B-link blockages in the concentrators. For additional information concerning BCI see the section on *Engineering and Administrative Considerations*.

10.6.4.2 Dial Tone Delay Peg Count

In the *5ESS*® switch, Section 4 of the TRFC30 report (DTDPC) is an indication of the ability of the machine to provide dial tone to customers within 3 seconds during the measuring interval. It is the primary measurement for evaluating the capability of providing originating customer service. Each call in the *5ESS*® switch is sampled for dial tone delay, and the number of calls sampled is recorded by the dial tone delay sample count (DTDSC). However, the DTDPC count is incremented only when an originating customer experiences dial tone delay of more than 3 seconds. Both DTDSC and DTDPC are available for each SM. These measurements are obtained from the TRFC15 and TRFC30 reports. The LUs should be investigated when DTD exceeds the percent grade of service.

The receipt of dial tone indicates only the readiness of the SM. It is possible, though highly improbable, that the administrative module or communication module (AM/CMP) could have problems which may cause the customer to experience post dial tone processing delay. Section 4 of the TRFC30 report provides measurements related to system delay (specifically blockage due to overload).

Typically, the most common reason for excessive dial tone delay is blocking in the LUs A- or B-links. Blocking in the HLSC or UTD is also possible, but this is not as likely as LU blockage. Another remote possibility for excessive dial tone delay is high SMP occupancy. If the dial tone delay peg count is excessive and if the tone decoder attachment delay is zero, then the SMP can be eliminated as the source of the trouble.

10.6.4.3 Reorder

The calls sent to reorder (REORD) count represents the number of calls sent to reorder tone. This count is similar to NOCKT in that it represents lost calls due to unavailable resources. This count does not isolate the trouble; instead, it indicates that overflow and usage counts for other resources should be observed. Some calls may be routed to reorder instead of announcements. Those calls do not represent calls lost due to unavailable resources. If this type of routing is employed, the value of the REORD count as a key service indicator is reduced. The reorder measurement is found in section 4 of the TRFC30 report.

10.6.4.4 Measurement Reports

The ROP provides a hard copy of input and output messages. This is where the output of the TRFC30 reports are provided. The sections of the TRFC30 report that are beneficial to an LU study are those listed:

- Section 4: Dial tone speed
- Section 6: Ineffective attempts
- Section 8: High level service circuits
- Section 9: Tone decoders

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- Section 11: Line unit
- Section 13: Processor occupancy
- Section 26: BRCS usage
- Section 27: Customer-originated recent change measures
- Section 29: BRCS feature measures
- Section 30: Terminal group measure
- Section 31: Individual dialing plan
- Section 32: Simulated facility group
- Section 33: Attendant group
- Section 34: Multiline hunt group (MLHG)
- Section 90: Line counts
- Section 144: Switch Group measurements.

10.6.5 FEATURE IMPACT

Since LU resources are based solely on the quantity of lines and the network usage, the implementation of new features has no impact on LUs.

Shared analog DN is the capability of allowing an analog call appearance to show up on an ISDN terminal. Analog shared DN impacts real time in the SM and it should be loaded in an LU with the understanding of the current capacity available in the SM. When an analog shared DN goes off-hook more processes take place in setting up the call than when a regular analog line goes off hook because the switch has to determine which ISDN terminal has the call appearance. Improper loading can cause real time, termination, and CCS capacity problems in the LU as well as in the SM.

10.6.6 TRANSITION IMPACT

Since the *5ESS*® switch network, TSIU and TMS, is virtually nonblocking; and since there are no junctor rearrangements required, LU deloading prior to a growth procedure, or LU rebalancing after a growth procedure is unnecessary.

10.6.7 LINE UNIT WORKSHEETS

10.6.7.1 Line Unit CCS Load Worksheet

This worksheet (Figure 10.6-8) gives the percent use of the line units total office CCS load today and at the EOP. If the office has mixed concentration ratios, the switch administrator should calculate a percent utilization for (1) each ratio, and (2) the total office.

The following paragraphs identify the columns of the Analog Line Units - CCS Load worksheet and describe the calculations required to complete the worksheet.

(A) Concentration Ratio: The various concentration ratios available.

(B) Engineering Blocking Criteria: The blocking criteria used to engineer this component. Valid entries are: 0.5, 1.0, 1.5, 2.0, 3.0, 4.0, 5.0, 10.0, 15.0, and 20.0.

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(C) Line Units Installed per Concentration Ratio: The number of line units installed per concentration ratio. Obtain the number from the switch or the TEO (telephone equipment order).

(D) CCS Capacity for Each Concentration Ratio: The stated CCS capacity for each concentration ratio based on the percent blockage. See Table 10.6-1 .

(E) Office CCS Capacity: The CCS capacity of the office. This figure is the total of each concentration ratio capacity.

LUs Installed per Concentration Ratio *Column C*	□	*CCS Capacity per* Concentration Ratio *Column D*	=	Office CCS Capacity *Column E*

(F) Main Station Demand Today: The number of main stations working in the office today. Obtain the number from the current working main station report.

(G) CCS Usage Demand Today: The line unit CCS usage demand that the office is running today. Obtain this number from the office engineering data.

CCS per MS Today *Column H*	□	MS Demand Today *Column F*	=	CCS Usage Demand Today *Column G*

(H) CCS per Main Station Today: The originating plus terminating CCS usage per main station that the office is running today. Obtain figure from the current office engineering data, or calculate by:

$$\frac{\text{CCS Demand Today (Column G)}}{\text{MS Demand Today (Column F)}} = \text{CCS/MS Today (Column H)}$$

(I) Main Station Demand - EOP: The main stations working at the end of the engineering period, or the highest main station demand in the engineering period. Obtain number from office forecast terminal report. If forecasted figure does not track with the actual growth, a new forecast will be needed.

(J) CCS per Main Station - EOP: The originating plus terminating CCS usage per main station at which the office is forecasted to be running by EOP. Obtain figure from office forecast data. This forecasted figure may not track with the actual office CCS per main station. If this happens, a new forecast for CCS per main station will be needed.

(K) CCS Usage Demand - EOP: The CCS usage demand that the office will serve at EOP.

MS Demand EOP *Column I*	□	CCS/MS EOP *Column J*	=	CCS Usage Demand EOP *Column K*

(L) Main Station Capacity Today: The number of main stations that the office is capable of serving today, based on the total office CCS capacity.

$$\frac{\text{Office CCS Capacity (Column E)}}{\text{CCS/MS Today (Column H)}} = \text{Main Station Capacity Today (Column L)}$$

(M) Main Station Capacity - EOP: The number of main stations that the office is capable of serving at the EOP.

$$\frac{\text{Office CCS Capacity (Column E)}}{\text{CCS/MS EOP (Column J)}} = \text{Main Station Capacity (Column M)}$$

(N) CCS Load Percent Utilization Today: The maximum CCS load that will be utilized today based on

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the current CCS per main station.

CCS Demand Today *Column G* Office CCS Capacity *Column E*	□ 100 =	CCS Load Percent Utilization *Column N*

(O) CCS Load Percent Utilization - EOP: The maximum CCS load that will be utilized by EOP based on the forecasted CCS per main station.

CCS Demand EOP *Column K* Office CCS Capacity *Column E*	□ 100 =	CCS Load Percent Utilization *Column O*

10.6.7.2 Line Unit Terminations Worksheet

This worksheet (Figure 10.6-9) provides the percent utilization of analog lines currently and also at the EOP. If the office has mixed concentration ratios, the switch administrator may need to calculate: (1) a percent utilization for each concentration ratio, plus (2) the total office. If the office growth is not tracking with the forecast, a new forecast is needed to ensure accurate capacity for EOP.

The following paragraphs identify the columns of the Analog Line Units - Terminations worksheet and describe the calculations required to complete the worksheet:

(A) Concentration Ratio: The various concentration ratios available with line units. Use the concentration ratio(s) appropriate for the office.

(B) Line Units Installed per Concentration Ratio: The number of line units per concentration ratio installed in the office. Obtain number from the switch, or the TEO (telephone equipment order).

(C) LENs per Ratio: The number of LENs (line equipment numbers) or terminations installed per concentration ratio.

(D) LENs Installed: The number of LENs installed in the office per concentration ratio. The total of this column gives the total installed LENs.

LUs Installed per Concentration Ratio *Column B*	□	LENs per Ratio *Column C*	=	LENs Installed *Column D*

(E) Percent Administrative Margin: Percent of installed LENs required for administrative purposes, e.g., inward and outward movement of main stations, spare terminals to permit rearrangement for loading purposes. Obtain value from the TEO. Use decimal representation of the percentage.

(F) LEN Capacity: The number of LENs available for use.

LENs Installed *Column D*	□	1 - Administrative Margin *Column E*	=	LEN Capacity *Column F*

(G) Main Station to Line Ratio: A ratio of the expected main station to LEN requirements. This column applies only where party line demand exists. For all other cases, the ratio is 1:1.

Current Main Stations Current Lines	or	EOP Main Stations EOP Lines

(H) Main Station Capacity: The number of main stations that the office is capable of serving.

LEN Capacity *Column F*	□	MS/Line Ratio *Column G*	=	MS Capacity *Column H*

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(I) Main Station Today: The main stations working in the office today. Obtain the number from the current working terminal report.

(J) Main Station Demand - EOP: The main stations working at the end of the engineering period, or the highest main station demand during the engineering period. Obtain the number from the office forecast terminal report. (Actual office growth may not track with the forecast terminal report. If this is the case, a new forecast is needed.)

(K) Termination Percent Utilization Today: The maximum number of LENs being utilized today.

$$\frac{\text{MS Demand Today (Column I)}}{\text{MS Capacity (Column H)}} \times 100 = \text{Terminations Percent Utilization Today (Column K)}$$

(L) Termination Percent Utilization - EOP: The maximum number of LENs that will be utilized during the period. (This is usually the number from the end of the engineering period.)

$$\frac{\text{MS Demand - EOP (Column J)}}{\text{MS Capacity (Column H)}} \times 100 = \text{Terminations Percent Utilizations - EOP (Column L)}$$

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Figure 10.6-1 Typical Intraoffice Line-to-Line Talk Path

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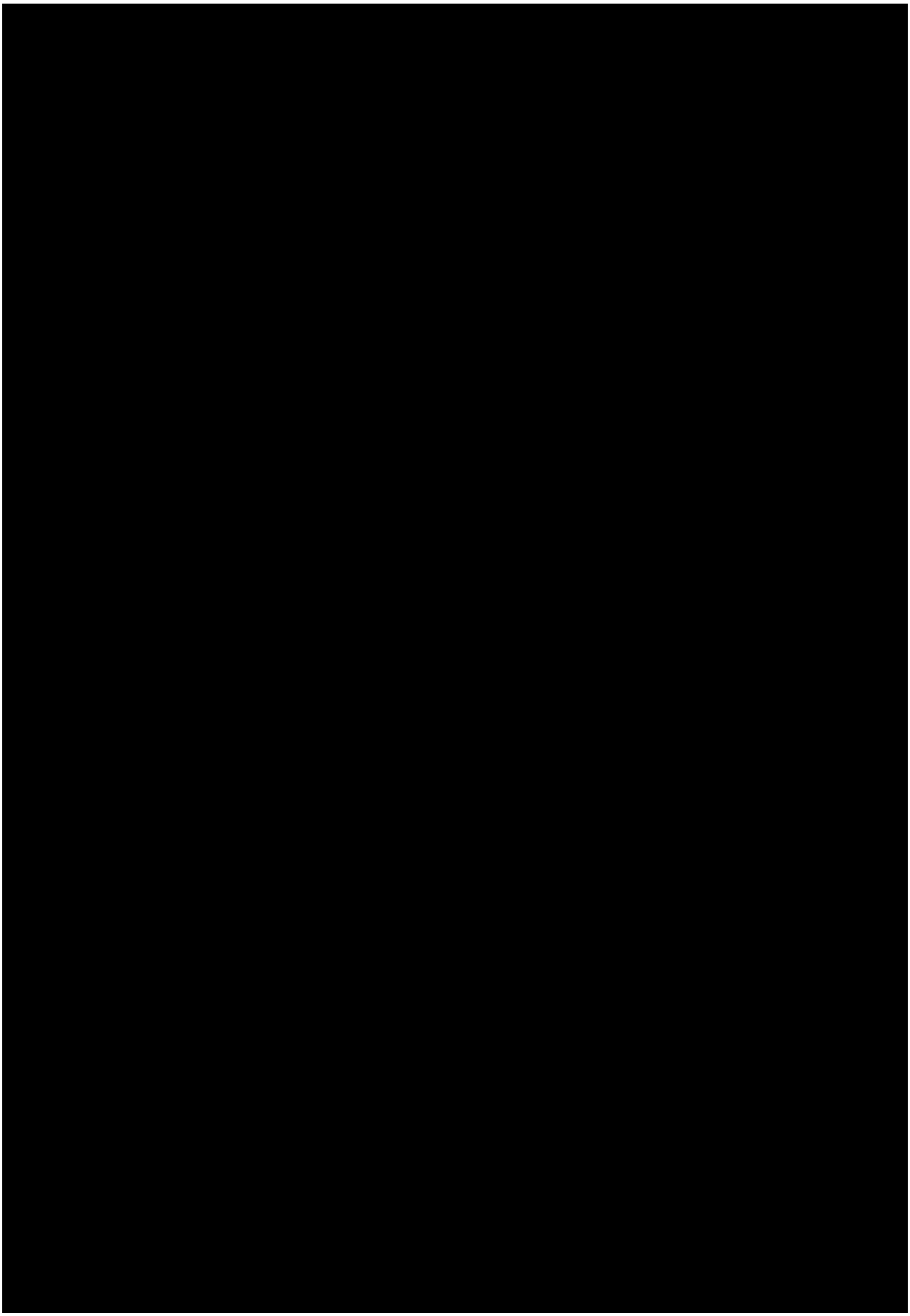

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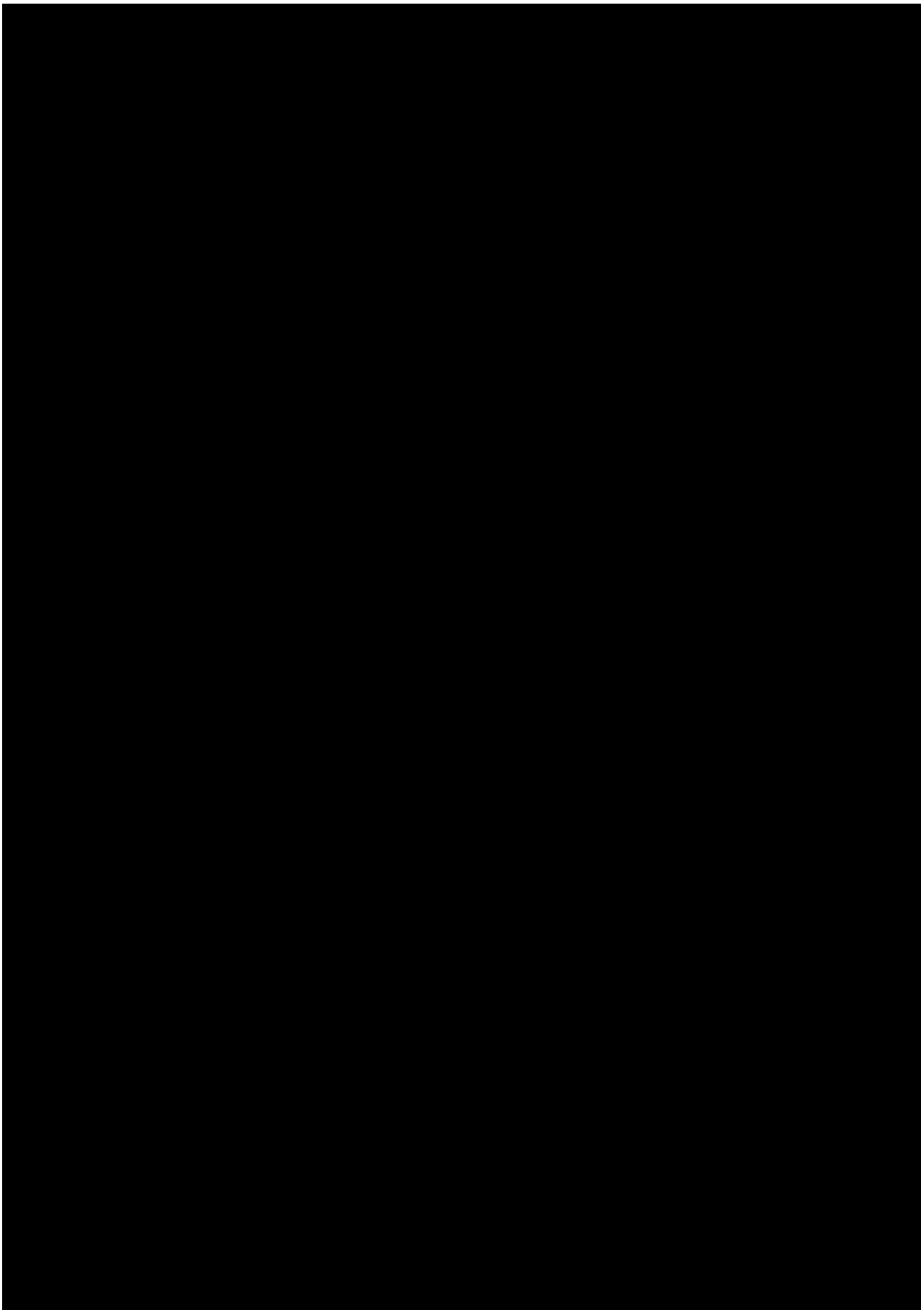

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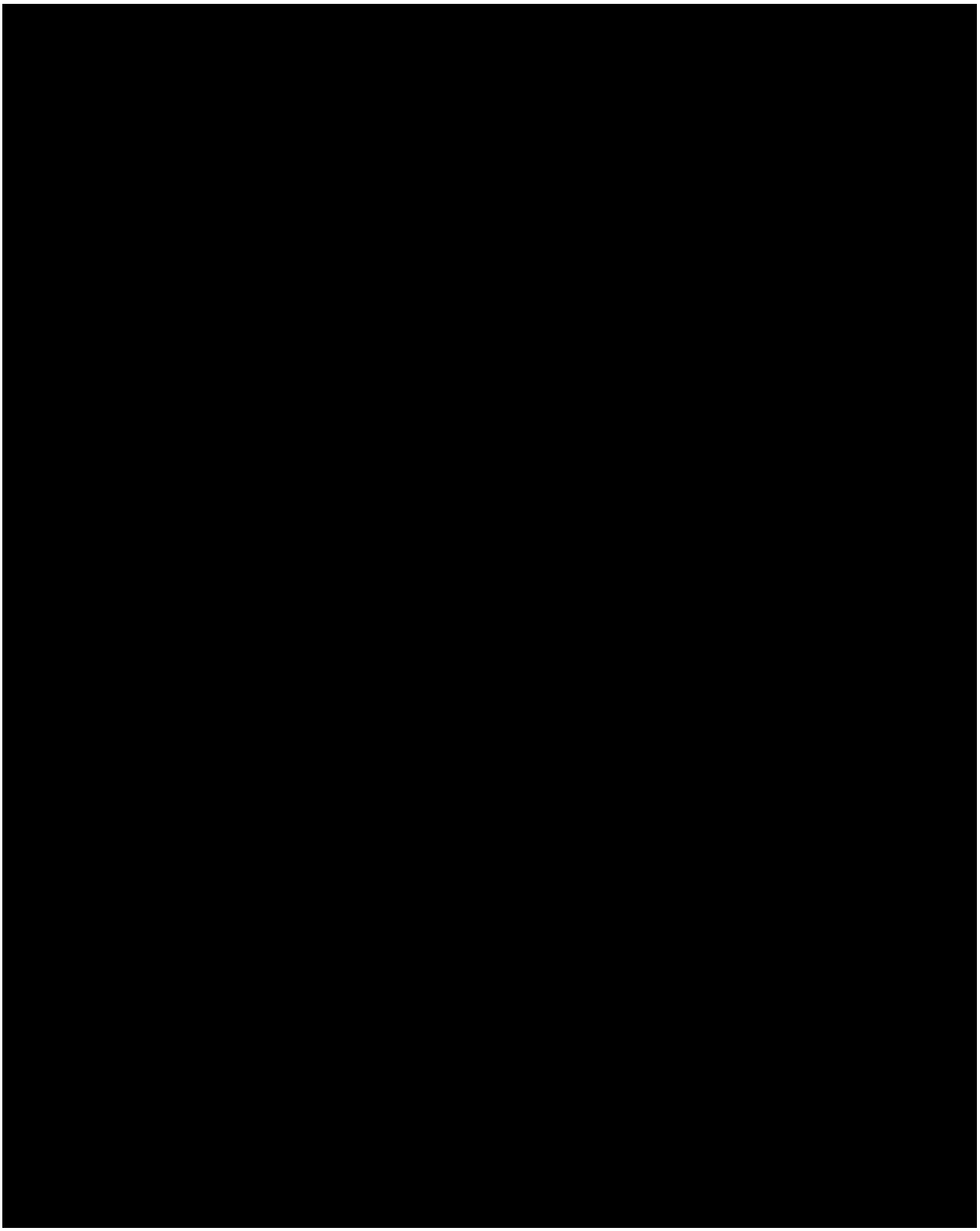

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Figure 10.6-2 LU2 and LU3 Concentrator Arrangements

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Figure 10.6-3 Typical 5ESS Switch Concentration (32 Total)

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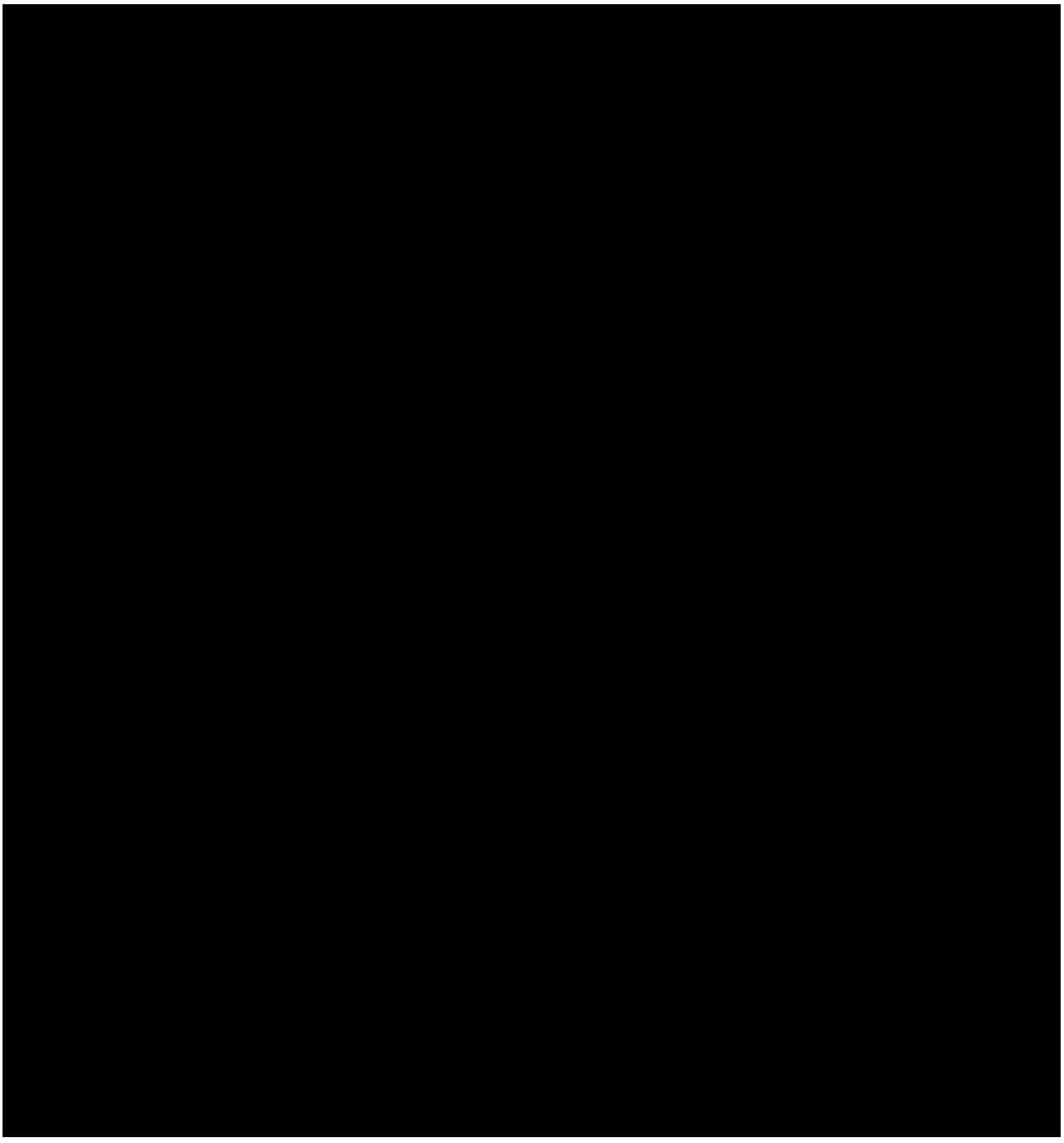

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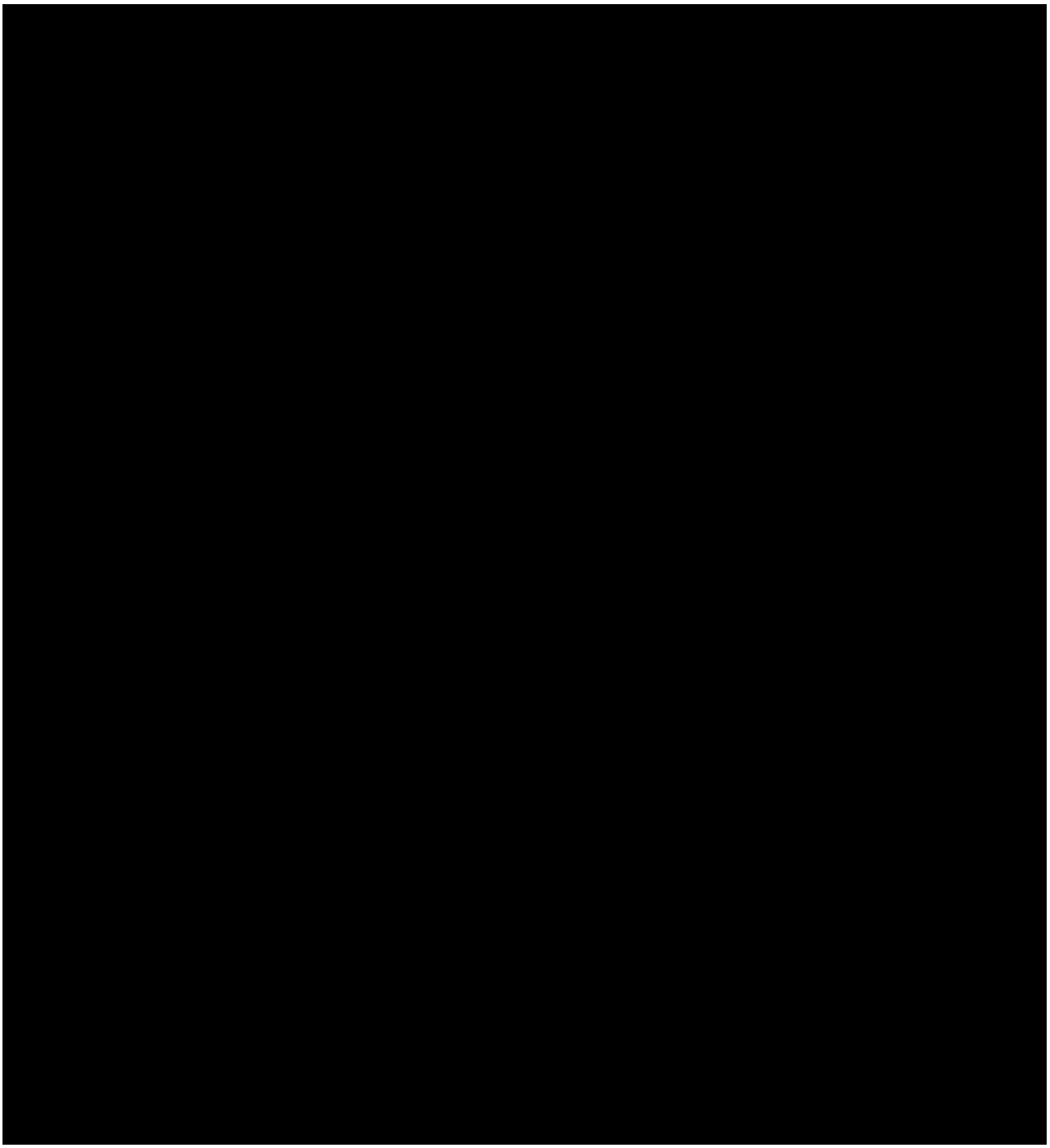

Figure 10.6-4 LU Load Service Curves

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Figure 10.6-5 LU2 and LU3 Concentrator Switch Stages

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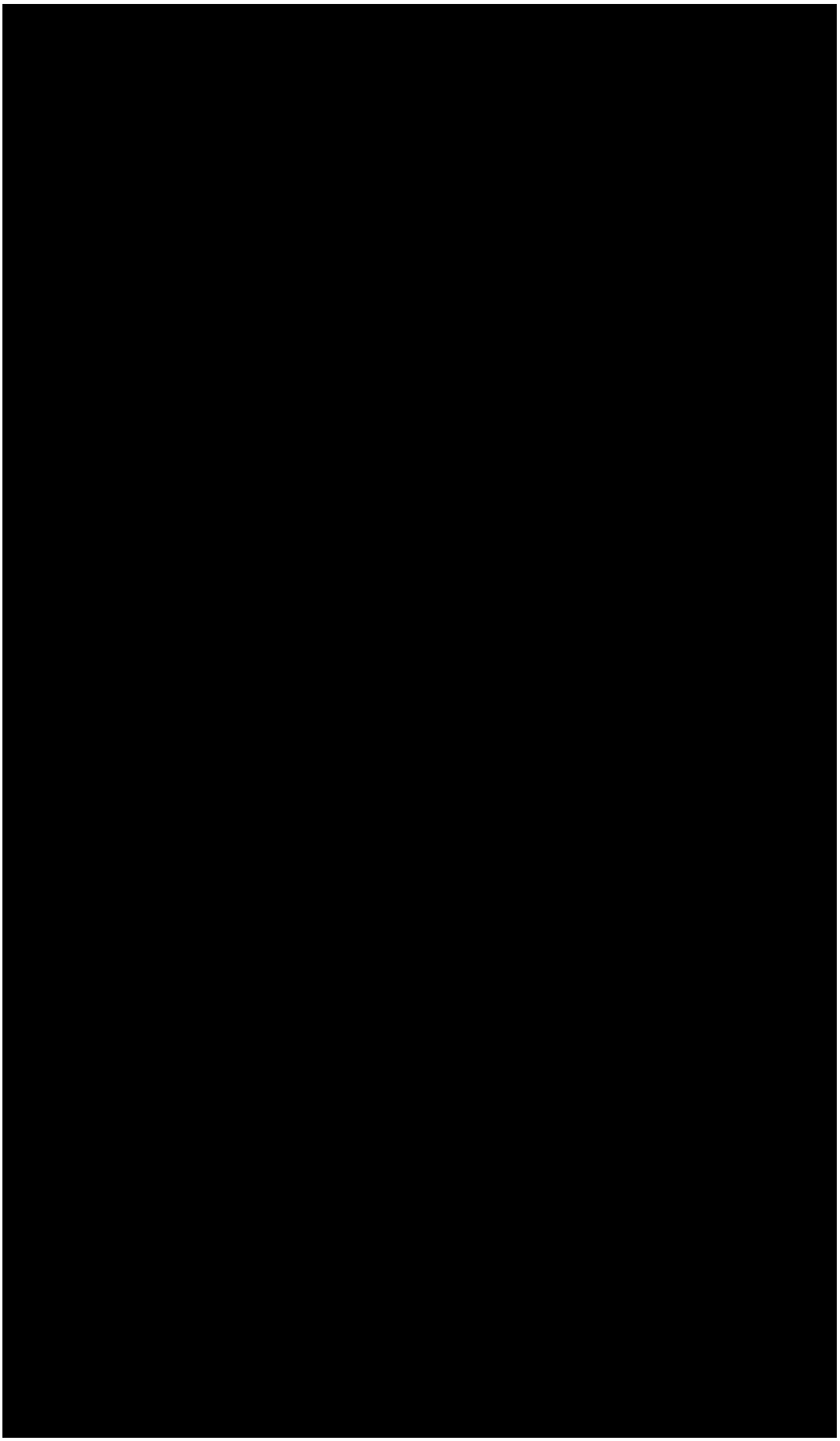

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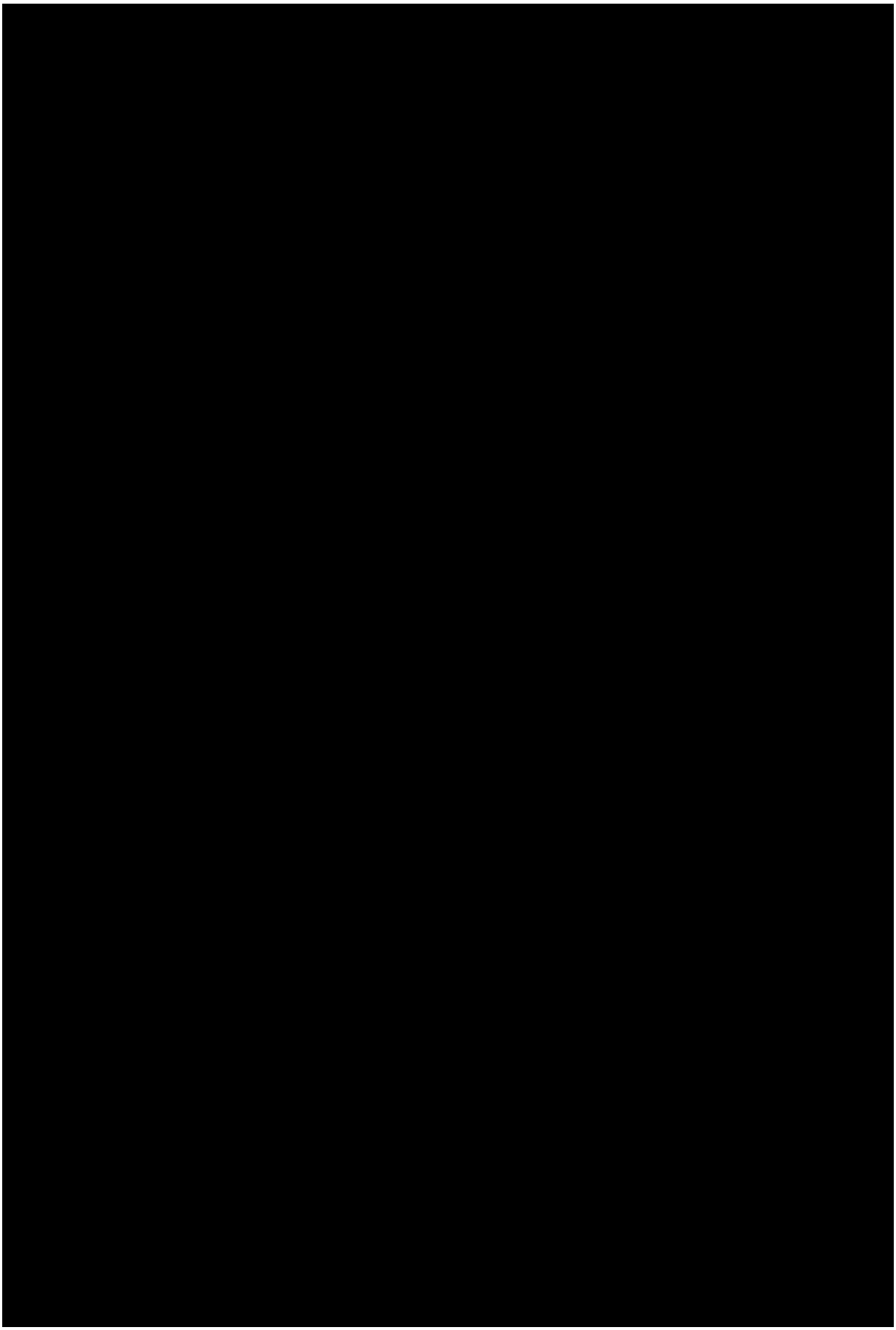

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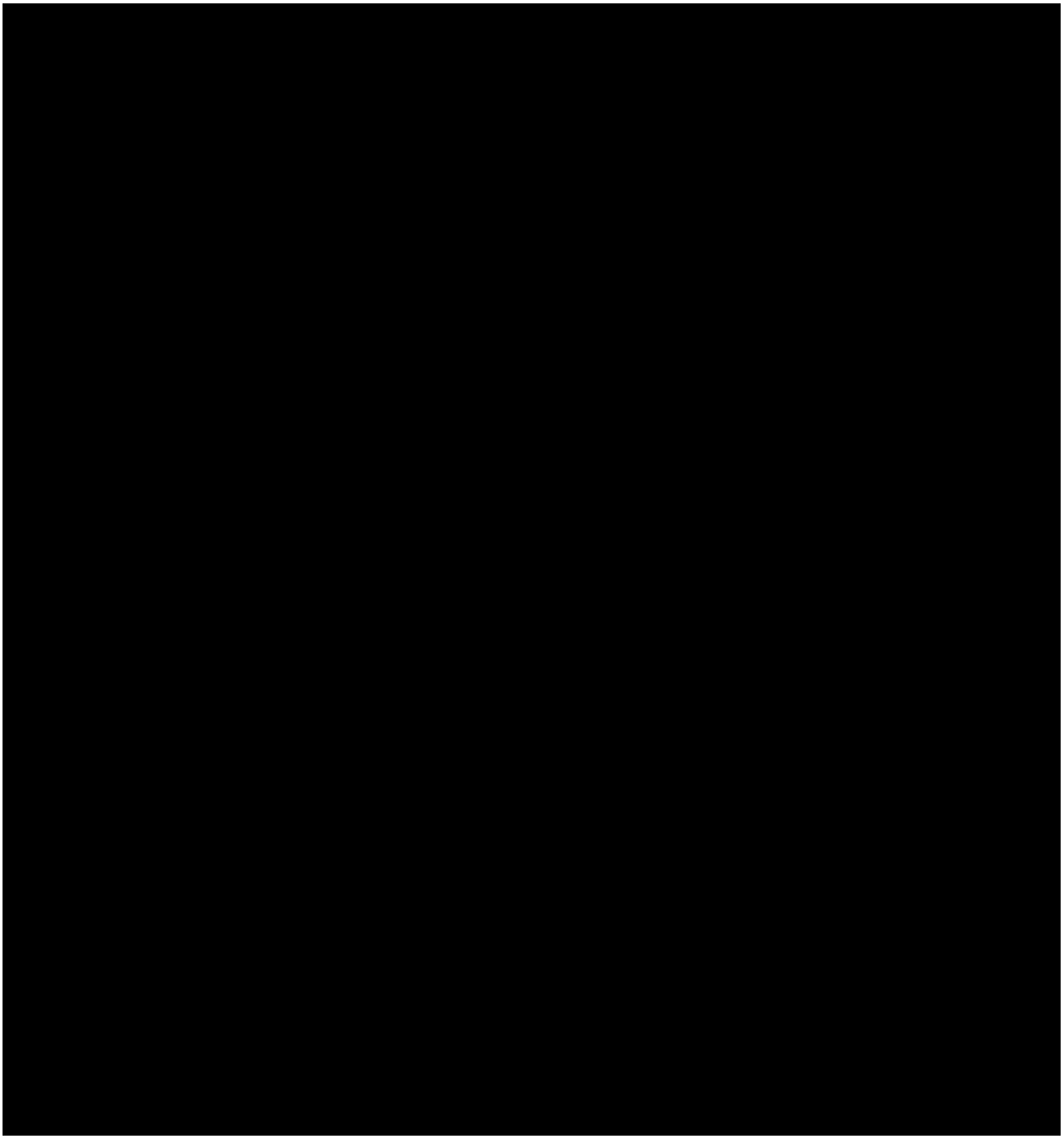
Figure 10.6-6 B-Link Random Slip Multiples



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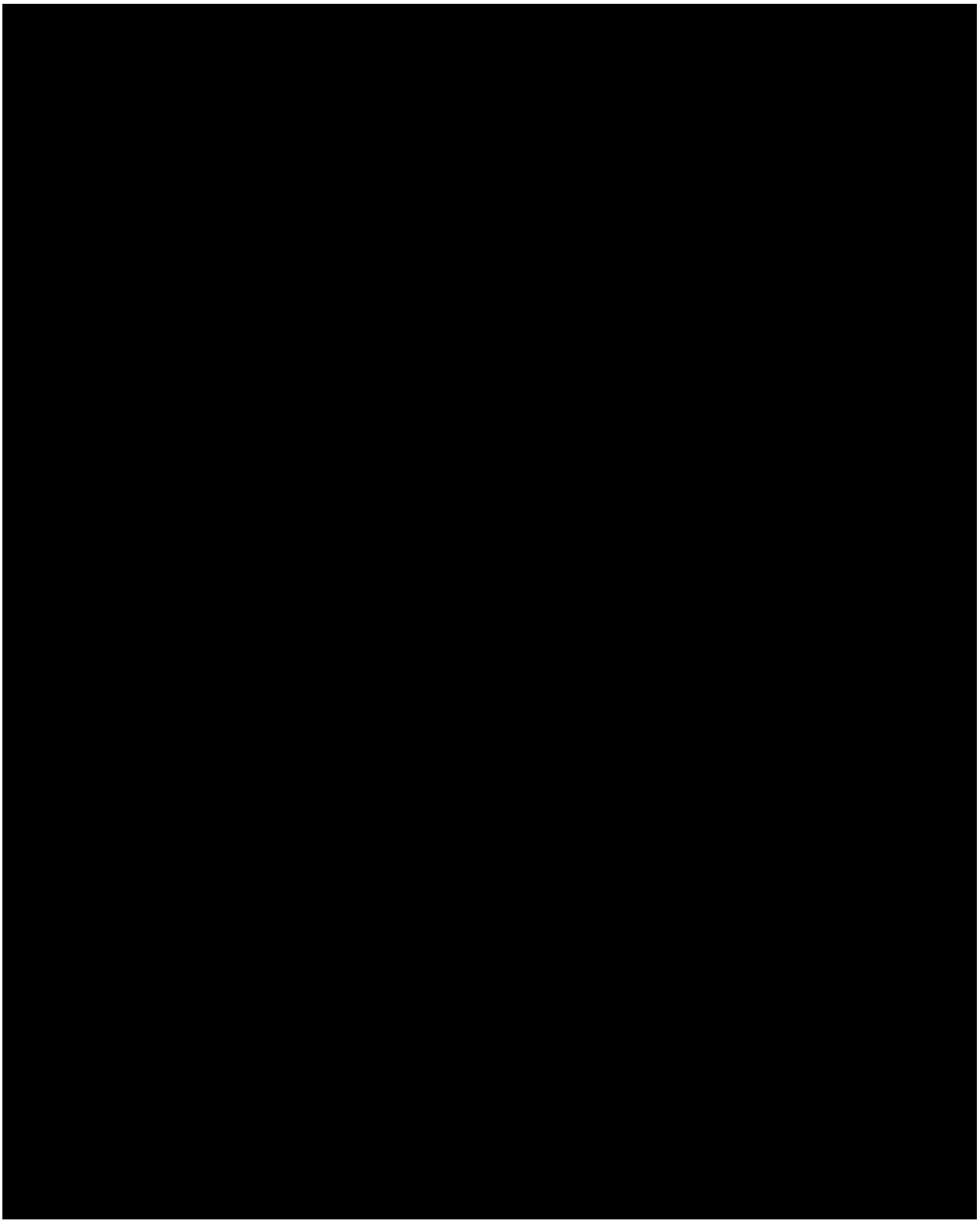

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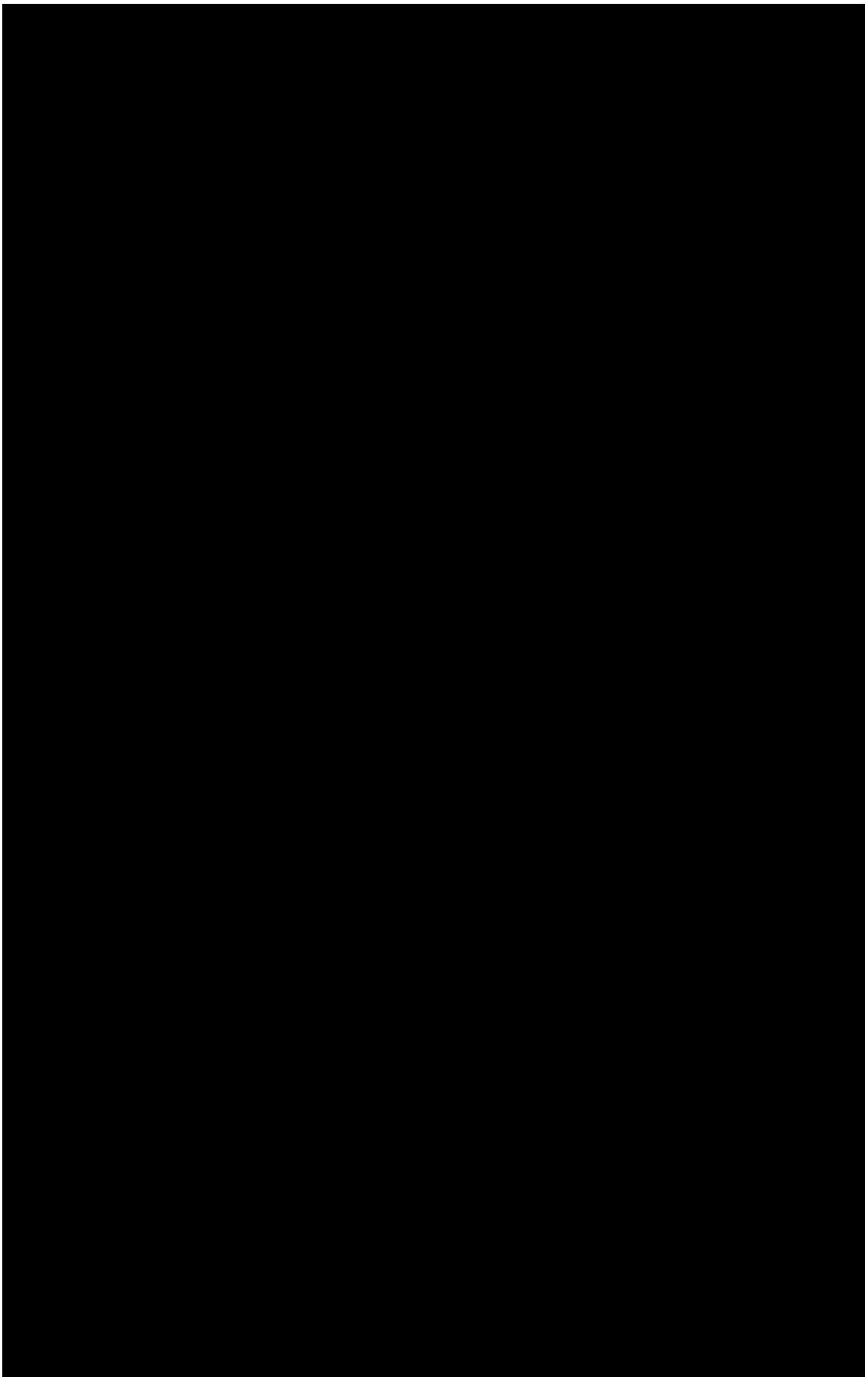

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Figure 10.6-7 Loading Priorities Worksheet

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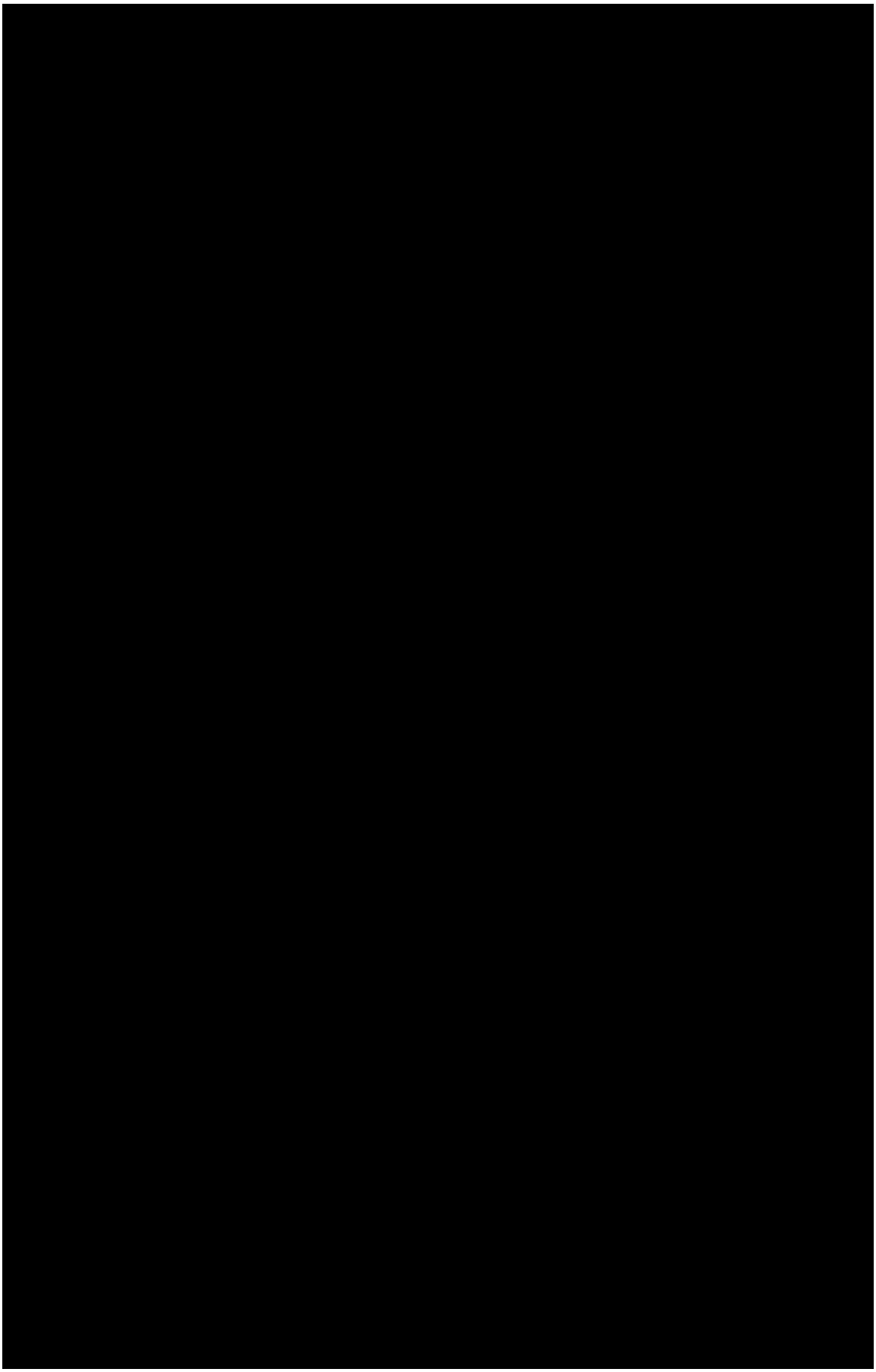

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Figure 10.6-8 Line Units CCS Load Worksheet

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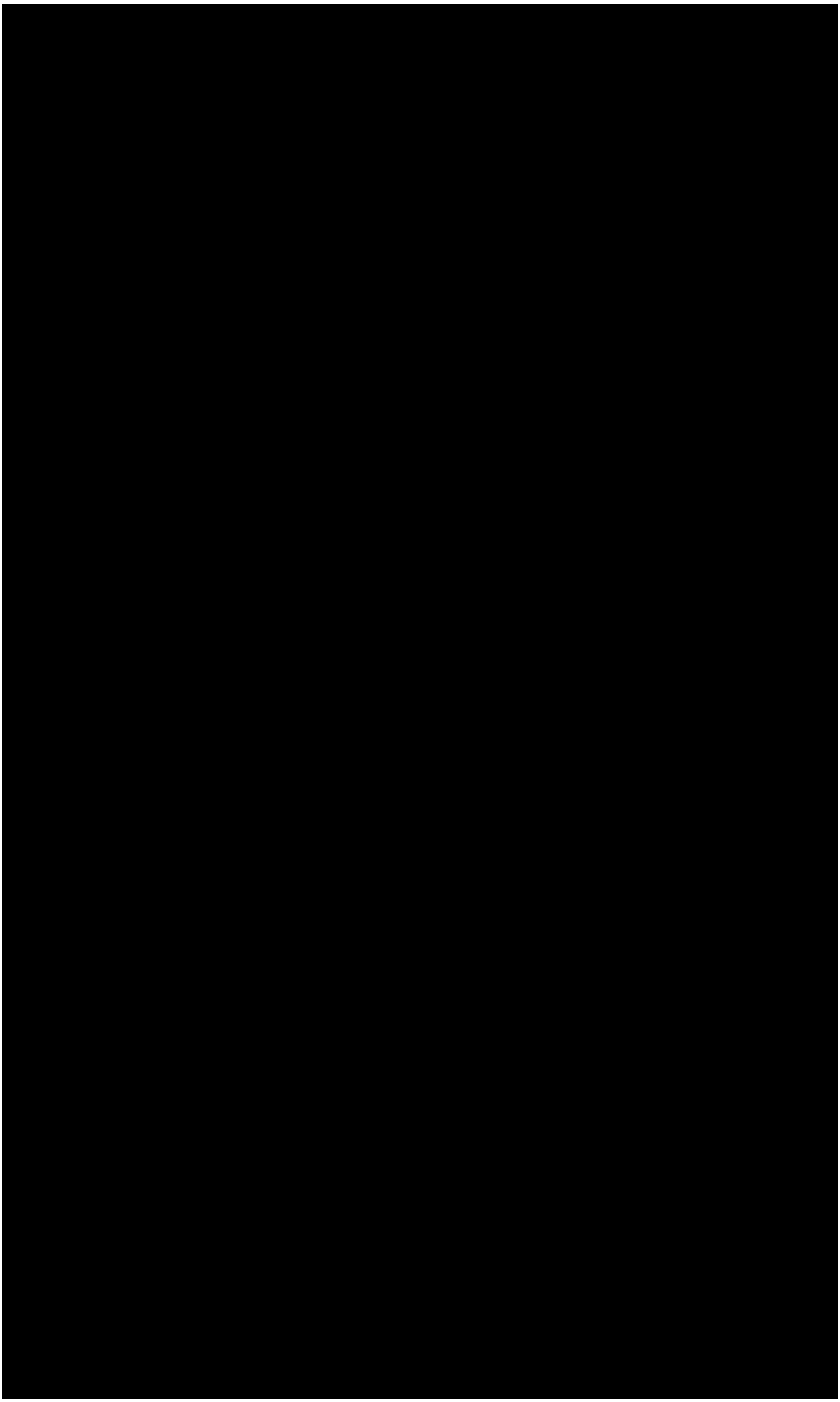

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Figure 10.6-9 Line Units Terminations Worksheet

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10.7 ACCESS INTERFACE UNIT

10.7.1 OVERVIEW

The access interface unit (AIU) represents an integrated and consolidated product approach to creating an all-purpose line interface unit for the SM/SM-2000. The AIU allows more flexibility and efficiency in engineering the *5ESS*® switch compared to previous line unit peripherals (LU3/ISLU).

The AIU platform supports the following subscriber line terminations:

- Analog POTS
- Analog COIN
- ISDN BRI (2B+D) ANSI U-Interface
- ISDN BRI (0B+D) Application Processor Simplified Messaging System Interface
- xDSL (ADSL with POTS/ISDN, SDSL, SHDSL)

The AIU is available in different configurations, including local and remote, as well as narrowband and narrowband/broadband.

Figure 10.7-1 AIU Configuration Options

The differnet AIU versions are summarized in Table 10.7-1 .

Table 10.7-1 AIU Types

Version	Name	Description
AIU	Access Interface Unit	Local version of the AIU. It is connected to an SM/SM-2000 via a PICB/(D)PICB interface. It supports narrowband lines (POTS, coin, ISDN).
BAIU	Broadband Access Interface Unit	Broadband local version of the AIU. It is connected to an SM/SM-2000 via a PICB/(D)PICB interface. It supports narrowband lines as well as broadband (ADSL, SDSL, SHDSL).
XAIU	Multiplex Access Interface Unit	Reduced cable version of the local AIU. The XAIU in conjunction with a PDXU is connected to the SM-2000 via PCT links. It supports

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		narrowband lines.
BXAIU	Broadband Multiplex Access Interface Unit	Broadband reduced cable version of the local AIU. The BXAIU in conjunction with a PDXU is connected to the SM-2000 via PCT links. It supports narrowband lines, as well as broadband.
EAIU	Expansion Access Interface Unit	Remote access AIU. It supports narrowband lines.
BEAIU	Broadband Expansion Access Interface Unit	Broadband remote access AIU. It supports narrowband lines, as well as broadband.

The EAIU with Emergency Standalone Capability feature (99-5E-7682) provides the capability for the EAIU to support Emergency Standalone operations when both primary communication links (with Control Channels) to the host *5ESS*® switch are lost for any reason. This is accomplished with the services of the external BZ-RS hardware and software, which takes over call processing for the affected EAIU shelf and supports basic loop-start POTS line-to-line calling, recorded announcements, and service to predefined emergency numbers such as "911".

Figure 10.7-2 ESA System Architecture

When in standalone mode, this feature initially will not support emergency calling for basic rate ISDN, ground-start subscribers (e.g. PBXs), nor support billing/traffic measurements.

- The "B" version of RCOMDAC is required to support emergency standalone via BZ-RS.
- Only the primary facilities with the Control Channels are connected to the BZ-RS.
- Up to 2 MF T1s are provided per BZ-RS to support access to emergency services such as 911, police, fire, hospitals, etc.
- Each BZ-RS can support up to 6 EAIUs.
- Scan and Distribute points from the RCOMDACs are also connected to the BZ-RS.
- The BZ-RS clock synchronization is via the emergency Multi-Frequency T1s or Building Integrated Timing Source (BITS).

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- The BZ-RS standalone mode call capacity limitation is the two EAIU primary links (2 * 23 = 46 Channels) and the emergency trunks (2 * 24 = 48 Channels).
- All line-to-line calls in standalone mode are intra-EAIU unless multiple shelves (connected to the same BZ-RS) are down, in which case calls may be inter-EAIU switched at the BZ-RS.
- Inter-EAIU calls can not be made between one EAIU that is in standalone and other EAIUs that are not in standalone mode.

10.7.1.1 BZ-RS Element Manager

- Each BZ-RS is equipped with a modem that connects to the Element Manager. The connection is provided either via dial-up lines or semi-permanent lines.
- The BZ-RS Element Manager is equipped with a modem, or in the case semi-permanent connections are used, a rack shall accommodate the pool of modems necessary on the EM side to communicate with the BZ-RSs.
- The BZ-RS Element Manager is able to manage up to 20 BZ-RS in the dial-up mode and up to 8 BZ-RS in the semi-permanent line mode.

Figure 10.7-3 BZ-RS Element Management Architecture

10.7.1.2 Broadband Element Manager

To support the xDSL capability, Lucent Technologies produces an Element Manager (EM), which is used for OAM of the xDSL equipment using the simple network management protocol (SNMP). The EM connects to the BAIU via either an Ethernet 10Base-T or over ATM PVC. The EM does not connect to the "telephony side" of the *5ESS*® switch. The operations and maintenance of the broadband service (done by the EM) and of the narrowband service (done through the *5ESS*® switch) are completely independent. Any

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coordination of these services is be done by the service provider. The EM consists of software that runs on commercially available workstation equipment. Technicians at the EM have the capability to configure the system, activate and deactivate service, receive alerts about equipment failures and query for the status of the system.

10.7.2 TRANSITION MANAGEMENT

10.7.2.1 Feature Availability

The AIU features are summarized in Table 10.7-2 .

Table 10.7-2 AIU Features

Release	Feature	Description
5E11	97-5E-3116	AIU Platform - POTS
	99-5E-2758	Coin Phone Functionality
	99-5E-4473	Broadband Backplane for AIU Platform
	99-5E-4474	xDSL on the BAIU
5E12	99-5E-2855	ISDN U-Interface (ANSI)
	99-5E-3560	Expansion AIU (EAIU) on SM-2000
	99-5E-3561	Integrated Metallic Testing on EAIU
5E14	99-5E-4596	Multiplex AIU (XAIU)
5E15 FR4	99-5E-7682	Emergency Standalone Application (ESA) for EAIU

10.7.2.2 Special Growth Considerations

AIU/EAIU	The minimum orderable AIU/EAIU configuration consists of two shelves.
EAIU ESA	The EAIU Emergency Standalone offer is only available for new start sites (Growth/Conversion is currently not supported). The BZ-RS Element Manager for the EAIU Emergency Standalone Application requires an ASM at the host with the following features: □ Recent Change feature 99-5E-4095 □ Proxy Database feature 99-5E-7127 □ Secure Features 322 and 523.
XAIU	The XAIU is orderable in four configurations: □ 6 Shelf □ Low Traffic □ 4 Shelf □ Medium Traffic □ 6 Shelf □ Medium Traffic □ 4 Shelf □ High Traffic

10.7.3 ENGINEERING CONSIDERATIONS

10.7.3.1 Architecture and Interfaces

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Figure 10.7-4 AIU Architecture and Interfaces

Refer to 235-100-200 *Hardware Description* for a functional description of the AIU hardware.

An example voice and data path of an ADSL line to POTS line call is shown in Figure 10.7-5 .

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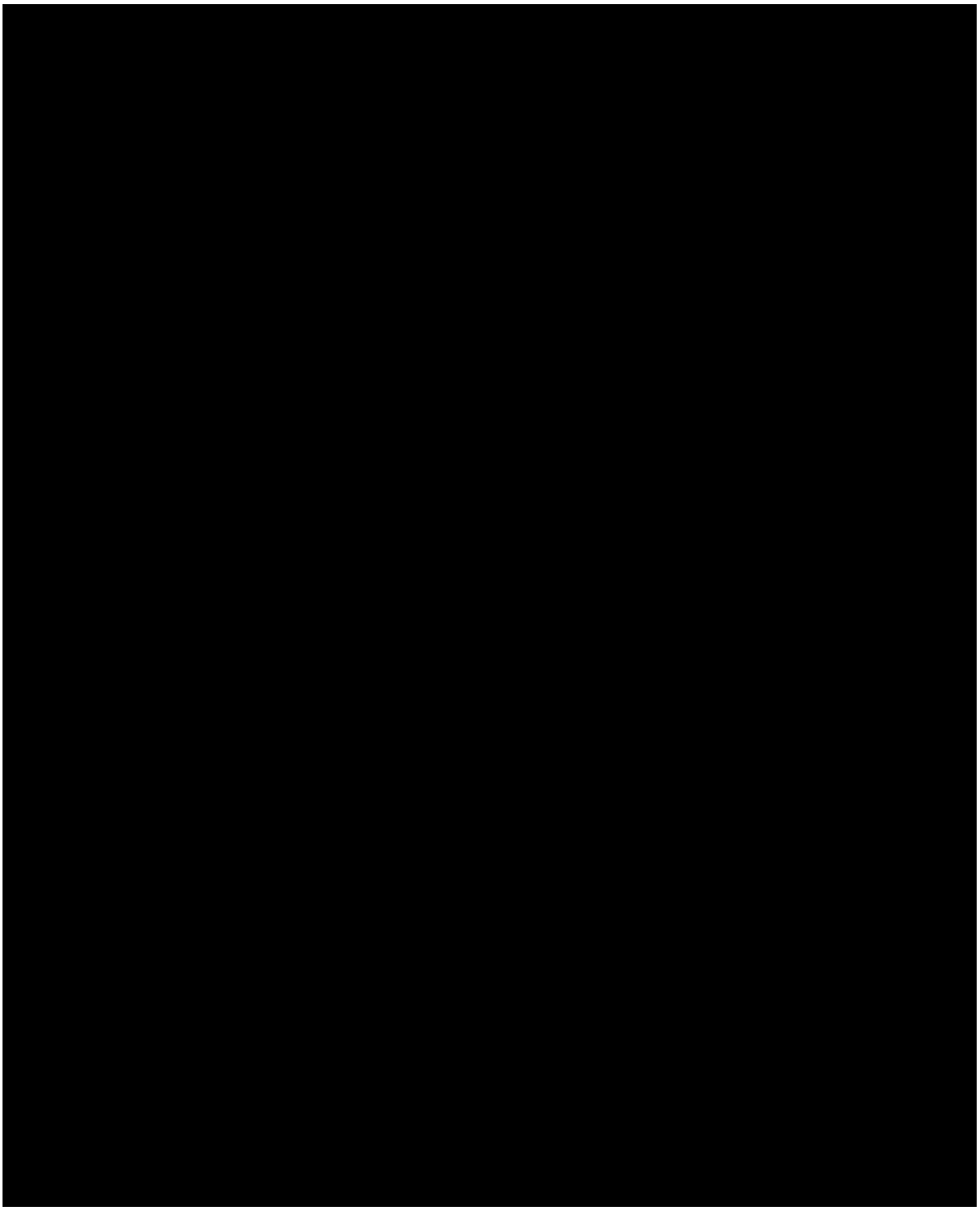

Figure 10.7-5 ADSL to POTS Call Example

The voice and data portion of the call are split at the ADSL pack. The voice portion is then connected to a POTS pack in this example via the MDF and is switched through the TSI of the SM/SM-2000 to another line.

10.7.3.2 Supported SM Platforms

Table 10.7-3 summarizes the platforms available on the various switching modules.

Table 10.7-3 Supported SM Platforms

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SM Type	AIU	BAIU	EAIU	BEAIU	XAIU	BXAIU
SM, RSM, ORM, TRM	■	■				
SM-2000, EXM-2000, DRM	■	■	■	■	■	■

10.7.3.3 Cabinet Configurations

Figure 10.7-6 AIU Cabinet Configuration

10.7.3.3.1 AIU Cabinet Configurations

The AIU is available to order with two or three units in an SM LTP Cabinet, and four or six units in a SM-2000 LTP Cabinet (also referred to as a Front Access Cabinet).

- Different AIU Shelf applications (i.e., AIU, BAIU, XAIU, etc.) can not be mixed in the same cabinet.
- Other Peripheral Units can not share the same cabinet.

10.7.3.3.2 EAIU Cabinet Configurations

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The EAIU is equipped in an Auxiliary Access Cabinet (AAC).

- The maximum number of EAIU shelves in an AAC cabinet is 6 (3 per side).
- EAIU and BEAIU shelves can not be mixed in the same cabinet.
- EAIUs from different SM-2000s can share the same AAC cabinet, however RG packs can not be shared by shelves associated with different SM-2000s and may require their own RGs.

10.7.3.3.3 XAIU Cabinet Configurations

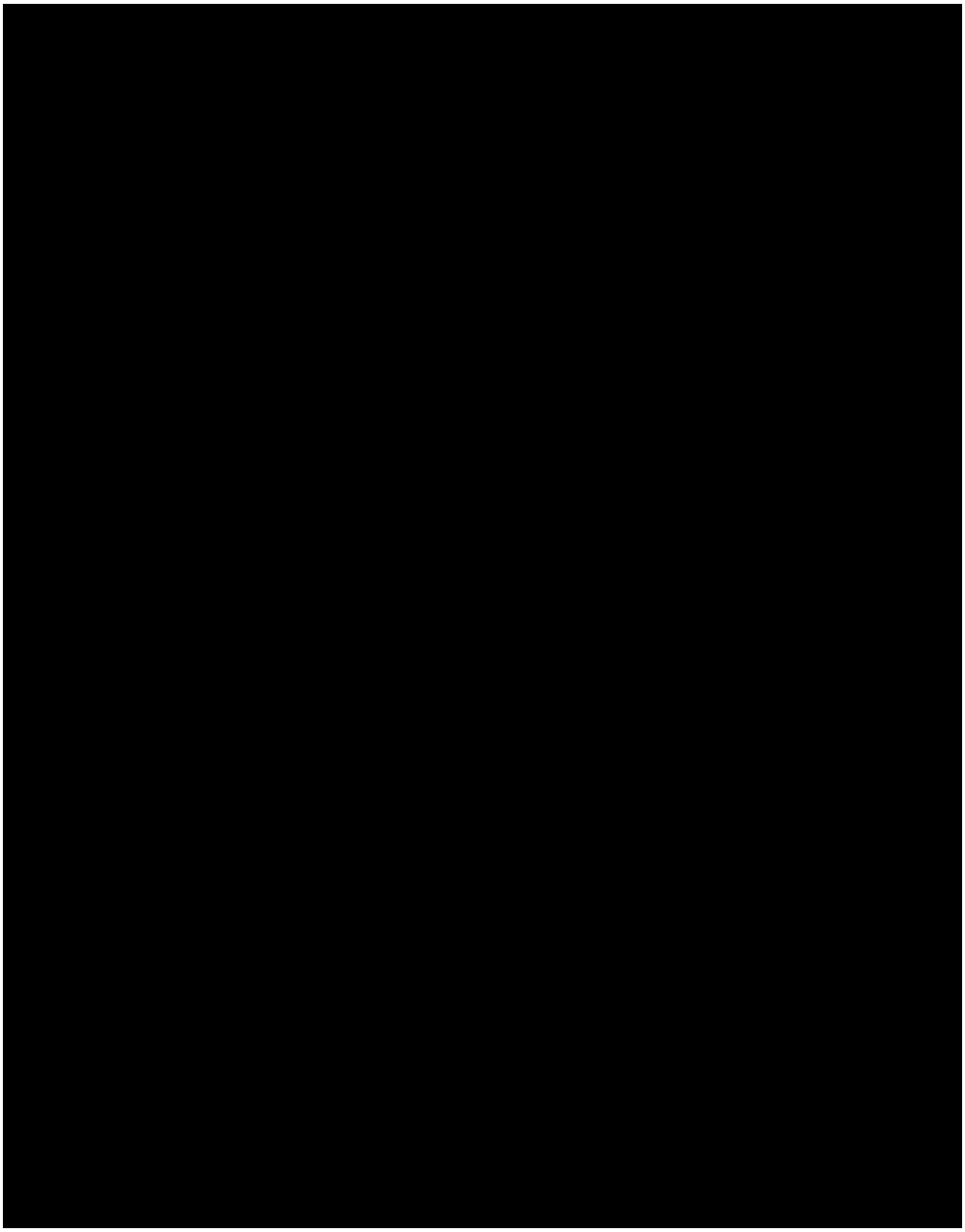

Figure 10.7-7 XAIU Cabinet Configuration

- The maximum number of XAIU shelves in a SM-2000 LTP cabinet is 6 (3 per side).
- No other equipment may be placed in this cabinet.

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- Different AIU Shelf applications (i.e., AIU, BAIU, XAIU, etc.) can not be mixed in the same cabinet.
- Two FCD circuit packs will always be equipped per XAIU cabinet (next to the Fan Unit at the rear of the cabinet).
- QPIDBs associated with QCOMDAC0 are connected to FCD0.
- QPIDBs associated with QCOMDAC1 are connected to FCD1.

10.7.3.3.4 Cabinet Thermal Considerations

For Analog line applications (does not apply to ISDN) with a High Day average traffic per line greater than 13 CCS, which corresponds to shelf configurations with more than 4 PIDB pairs equipped:

- The maximum number of shelves equipped in an SM LTP Cabinet is restricted to 2.
- The maximum number of shelves in a SM-2000 LTP is 4 (2 per side).
- No other equipment may be placed in this cabinet.

xDSL applications:

- For pure DSLAM applications (xDSL APs only), the maximum number of shelves per cabinet is 4 (2 front + 2 rear).
- When the application calls for mixing any narrowband/broadband application circuit pack in any shelf location, the maximum number of shelves per cabinet is 4 (2 front + 2 rear).
- When one shelf contains both narrow band and broad band packs and the remaining two shelves are narrow band only shelves then the same rules apply as for a DSLAM. The mixed shelf configuration must be in the bottom or middle shelf.
- When only one of the shelves per cabinet side is a DSLAM shelf, then the DSLAM shelf must be restricted to either the bottom or middle shelf. Each side can equip up to two narrowband shelves (one for high traffic POTS).

10.7.3.3.5 BZ-RS Cabinet Configuration

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Figure 10.7-8 MISC Cabinet Configuration for BZ-RS

- The BZ-RS can not share the same cabinet with the EAIU and will be equipped in a MISC cabinet co-located in the same building with the EAIUs with a maximum of 3 BZ-RS units per cabinet.
- This MISC cabinet configuration is NEBS Level 3 and UL compliant.
- The BZ-RS has a separate PC based management system that is equipped in a MISC cabinet co-located in the same building as the Host *5ESS*® switch and within 328 cable feet of the ASM.

10.7.3.4 Shelf Configurations

Figure 10.7-9 General AIU Shelf Layout

The AIU shelf has two COMDAC slots and 20 Application Pack slots that are equipped depending on the types of lines terminated as shown below.

AP	NB Backplane	BB Backplane	(Q/R)COMDAC	RG	AFM
POTS	□	□	□	□	
COIN	□	□	□	□	
ISDN	□	□	□		
ADSL		□			□
SDSL		□			□
SHDSL		□			□

- The ADSL, SDSL, SHDSL, and AFM packs are only supported on the Broadband shelf options. Any cross-connections required between the ADSL packs and POTS/ISDN packs in the same or other AIU shelf will be made at the Main Distribution Frame (MDF).
- Each Broadband Shelf can be equipped with either one DS1 AFM pack, or two DS3/OC3c AFM packs, which operate Active/Standby.
- The DS1 AFM packs do not support daisy-chained shelf configurations.
- The DS3/OC3c AFM interface may be daisy-chained together to share the available bandwidth.
- Different types of AFM interfaces can not be mixed in the same shelf or same daisy-chained configuration.
- The daisy-chained shelves do not have to all be physically co-located or controlled by the same SM.
- The maximum number of shelves that may be daisy-chained depends on whether the timing source is set to line-timed or free-running as follows:
  - Line-timed: Up to 8 shelves due to the accumulated degradation of the timing signal quality as it passes through each shelf (subject to AFM traffic engineering)
  - Free-running: Based on AFM traffic limits.

10.7.3.5 Pack Options

Table 10.7-4 lists the available AIU circuit packs.

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Table 10.7-4 Available Packs

Pack Type	Pack Code	Ports	Interface	Notes
COMDAC	DAC100B	1	PICB	Used for Local AIU applications. PICB and (D)PIDB ports are duplexed.
		6	(D)PIDB	
RCOMDAC	DAC624B	6	DS1	Used for EAIU applications. Eight Scan points are available. Two are fixed and six are user defined. Two Distribute points are available. One is fixed and one is user defined. The "B" version is required to support emergency standalone via BZ-RS.
QCOMDAC	DAC630B	6	QPIDBs	The QCOMDAC used to connect the XAIU shelves to the FCD via QPIDBs. Each QCOMDAC will have up to 6 QPIDBs.
AFMDS1	LPA942	8	ATM over DS1	Maximum of 1 pack per shelf. Does not support Daisy Chaining of BAIU shelves.
AFMDS3	LPA901	2	ATM over DS3	Maximum of 2 packs per shelf if pack redundancy is required Each AFM Pack has 2 DS3 ports 2nd port is only used for Daisy Chaining BAIU shelves (not to the ATM switch) if required.
AFMO	LPA920	2	ATM over OC3c	Maximum of 2 packs per shelf if pack redundancy is required Each AFM Pack has 2 OC3 ports 2nd port is only used for Daisy Chaining BAIU shelves (not to the ATM switch) if required.
POTS AP	LPZ100D	32	2-wire	Programmable POTS
COIN AP	LPC100B	16	2-wire	Supports Coin Phone and Analog POTS Lines
ISDN AP	LPU116	16	2-wire	ANSI U-Interface
ADSL AP	LPA414	4	2-wire	ADSL with ISDN Splitters
	LPA417	16	2-wire	ADSL with ISDN Splitters
	LPA419	16	2-wire	ADSL with POTS Splitters
	LPA432	32	2-wire	ADSL with POTS (Does not include on board Splitters)
SDSL AP	LPS716	16	2-wire	2B1Q-based symmetric DSL rate-adaptive/rate-provisionable from 144 kbps to 2.32 Mbps
SHDSL AP	LPS702	16	2-wire	16 2-wire ATM cell transport over TC-PAM SHDSL line-coding SHDSL symmetric rates from 192 kbps to 2.304 Mbps
RG	RGP100B	N/A	N/A	Supports Standard 20 Hz, 25 Hz, and 30 Hz Power Ringing for Analog Lines
TAP	TAP100B	N/A	N/A	Provides Optional Integrated Metallic Testing for EAIUs
Blank	408356137	N/A	N/A	The blank faceplate is required in any empty slot to maintain proper airflow and to hold the unused T/R connector associated with that slot

10.7.3.6 Spares

- (Q/R)COMDACs are always engineered as mated pairs.
- RGs (if required) are always engineered as mated pairs.
- AFMs (with the exception of the AFMDS1), can optionally be engineered as mated pairs.
- No spare APs or line circuits are supported on the AIU platform.

10.7.3.7 Capacities

10.7.3.7.1 AIU Capacities

The AIU on an SM may be engineered to take advantage of DI concentration, which occurs when more that

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8 PIDBs are equipped on a single DI. For example, if 10 PIDBs are equipped on DI 0 and 6 PIDBs are equipped on DI 1, then DI concentration will occur. PIDB assignments can be verified using RC/V view 18.7. This is the default engineering recommended for the SM where the Active/Active COMDACs are engineered as load-shared (Duplex). The advantage is that if one COMDAC fails, the other COMDAC is able to handle the engineered load with no degradation in service. The Simplex PIDB loading principles used for the SM-2000 may also be used on the SM if desired.

In the SM-2000 environment, there is no concentration at the DX so there is no consistent advantage in engineering the COMDACs as load-shared and will not be used as the default engineering for the SM-2000, however the loading principals used for the SM may also be used if desired.

Table 10.7-5 lists the simplex and duplex PIDB CCS capacity values based on the number of PIDB pairs equipped.

Table 10.7-5 Simplex and Duplex PIDB CCS Capacity

PIDB Pairs	Simplex PIDB CCS Capacity			Duplex PIDB CCS Capacity		
	ABS (1.5% TBLK)	EVE (4% TBLK)	HD (7% TBLK)	ABS (1.5% TBLK)	EVE (4% TBLK)	HD (7% TBLK)
1	1,728	1,797	1,843	864	899	922
2	3,686	3,917	4,147	1,843	1,958	2,074
3	5,875	6,221	6,221	2,938	3,110	3,110
4	7,834	8,294	8,294	3,917	4,147	4,147
5	9,792	10,368	10,368	4,896	5,184	5,184
6	11,750	12,442	12,442	5,875	6,221	6,221

Any ISDN subscribers will require DPIDB pairs to the PSU, which will reduce the number of PIDBs that may be equipped.

- 4 ISDN BRI D-Channels are multiplexed into a single DPIDB TS, *provided all four are on the same ISDN AP and assigned to the same Protocol Handler in the PSU.*
- Each ISDN PPB Channel will require 1 TS on the DPIDB.
- Additional DPIDB TSs will be required to support any ISDN On-Demand B (ODB) based on the estimated average traffic for this service.
- The total packet capacity of the TS is 36 CCS. Q.931 signaling has been determined to require approximately 0.02 CCS. Any D-Channel packet traffic places an additional load on the 1/4 TS. The 1/4 TS is estimated to have a capacity of 8 CCS.

10.7.3.7.2 EAIU Capacities

The EAIU RCOMDAC uses the same Space Switch and routing algorithm used by the AIU COMDAC. The only difference is that instead of switching PCM Highway TSs from the APs to PIDB/DPIDBs, they are switched to channels on DS1 facilities. Also, since there is no PICB, TS1 on the first facility pair is reserved for control signaling from the MH in the SM-2000.

In order for the RCOMDAC to map TSs to 24-channel DS1s, a TS stuffing pattern is used resulting in one out of every four TSs being left unused as shown in Table 10.7-6 .

Table 10.7-6 RCOMDAC Stuffing Pattern

TSGRP	RCOMDAC 0		RCOMDAC 1	
	TSs	PATTERN	TSs	PATTERN
0	0**CS**3 45**S**6 ...	C	0**C**2**S** 456**S** ...	D
1	**S**123 **S**567 ...	A	0**S**23 4**S**67 ...	B
2	01**S**3 45**S**6 ...	C	012**S** 456**S** ...	D
3	**S**123 **S**567 ...	A	0**S**23 4**S**67 ...	B
4	01**S**3 45**S**6 ...	C	012**S** 456**S** ...	D
5	**S**123 **S**567 ...	A	0**S**23 4**S**67 ...	B

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The RCOMDAC can connect any PCM Highway time slot to the same time slot on any facility. The only time slot switching within the unit takes place in the Application Packs, which can connect any incoming line to any of the available time slots on the PCM highway connected to either RCOMDAC.

What is important to note is that due to the stuffing pattern and the fact that the routing algorithm does not re-assign time slots on existing calls to resolve contention, there is a potential for blocking at very high occupancies even if there may still be channels available on the facilities. For example, consider an EAIU equipped with 2 DS1 pairs. On one pack 31 out of 32 lines are busy. There will be one time slot (TS X) left on from this pack to the PCM highway. Now consider that on four other packs, a call has already been assigned to time TS X on their respective PCM highways. Therefore, one cannot complete a call on the 32 line of the initial line card since all four of the TS Xs on the DS1s are already in use.

A detailed Bell Labs performance study was conducted in 2001/2002 that modeled the various sources of blocking along with a mix of long and short holding times that resulted in new recommended occupancies to achieve the average blocking objectives of 1.5% ABS, 4% EVE, and 7% HD. The EAIU CCS capacities at recommended occupancy levels is shown in Table 10.7-7

Table 10.7-7 EAIU CCS Capacity

Facility Pairs	CCS Capacity *(Recommended Occupancies)*		
	ABS	EVE	HD
1	1,242 (75%)	1,325 (80%)	1,325 (80%)
2	2,538 (75%)	2,707 (80%)	2,707 (80%)
3	4,090 (80%)	4,345 (85%)	4,345 (85%)
4	5,472 (80%)	5,814 (85%)	5,814 (85%)
5	7,283 (85%)	7,711 (90%)	7,711 (90%)
6	8,752 (85%)	9,266 (90%)	9,266 (90%)

If any ISDN subscribers are also supported, this table will need to be adjusted to account for the resources used by the D-Channels and any PPB-Channels.

- DPIDBs are not used for ISDN on the EAIU.
- Up to 4 ISDN BRI D-Channels are multiplexed into a single DS1 channel.
- Each ISDN PPB channel will require 1 channel on the DS1.
- Additional DS1 channels will be required to support any ISDN On-Demand B (ODB) based on the estimated average traffic for this service.
- The traffic capacity is then calculated based on the remaining channels engineered at the specified recommended occupancies.

10.7.3.7.3 XAIU Capacities

Unlike AIU PIDBs, the QPIDBs between the XAIU shelves and the FCD are pre-cabled at the factory based on the specific configuration option selected as shown in Table 10.7-8 .

Table 10.7-8 XAIU Shelf Timeslots

Configuration	Shelves	Per XAIU Shelf		
		QPIDB Pairs	TSGRPs	TSs
Low Traffic	6	2	4	126
Medium Traffic	4	3	6	190
	6	4	8	254
High Traffic	4	6	12	382

- Each TSGRP consists of 32 TSs
- 2 TSs from the first QPIDB pair are used for the Control TSs

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The XAIU CCS capacities at recommended occupancy levels is shown in Table 10.7-9 .

Table 10.7-9 XAIU CCS Capacity

Configuration	Shelves	CCS Capacity *(Recommended Occupancies)*		
		ABS	EVE	HD
Low Traffic	6	3,629 (80%)	3,856 (85%)	4,082 (90%)
Medium Traffic	4	5,814 (85%)	6,156 (90%)	6,156 (90%)
	6	7,772 (85%)	8,230 (90%)	8,230 (90%)
High Traffic	4	11,689 (85%)	12,377 (90%)	12,377 (90%)

If any ISDN subscribers are also supported, this table will need to be adjusted to account for the resources used by the D-Channels and any PPB-Channels.

- DPIDBs are not used for ISDN on the XAIU.
- Up to 4 ISDN BRI D-Channels are multiplexed into a single QPIDB TS.
- Each ISDN PPB channel will require 1 TS.
- Additional TSs will be required to support any ISDN On-Demand B (ODB) based on the estimated average traffic for this service.
- The traffic capacity is then calculated based on the remaining channels engineered at the specified recommended occupancies.

10.7.3.7.4 xDSL on BAIU, BEAIU, and BXAIU Capacities

The traffic capacities of the voice (POTS/ISDN over ADSL) is the same as the AIU, EAIU, and XAIU previously discussed. This section will now focus on engineering the data portion.

Table 10.7-10 Maximum ATM Feeder Traffic Capacities

Interface Type	Mbps	ATM Cells per second
DS1 (x N DS1s, where N = from 1 to 8)	1.386	3600
DS3	44.210	104000
OC3c	149.760	353207

- The data traffic over the AFM does not impact the SM/SM-2000 call capacities.
- To simplify bandwidth engineering for an initial order, it is recommended to engineer the ATM links at no more than 70% occupancy based on the line rate (i.e., 155.52 Mbps * 0.70 for OC3c), reserving 30% for the associated overhead, signaling, and OA&M. After which Traffic reports should be used to ensure that the total cell rate/bandwidth does not exceed the capacities specified in the table above.
- For a Daisy-Chained configuration, the sum total for all the shelves can not exceed the capacity of the AFM interface to the ATM network.

Table 10.7-11 Traffic Patterns

Traffic Type	Traffic Parameter	G.Lite	Full
ADSL	Minimum Downstream Line Speed (Mbps)	1.024	1.024
	Minimum Upstream Line Speed (Mbps)	0.384	0.384
	Maximum Downstream Line Speed (Mbps)	4.480	9.984
	Maximum Upstream Line Speed (Mbps)	1.024	1.024
SDSL	Minimum Line Speed (Mbps)	0.144	0.144
	Maximum Line Speed (Mbps)	2.320	2.320
SHDSL	Minimum Line Speed (Mbps)	0.192	0.192
	Maximum Line Speed (Mbps)	2.304	2.304

Table 10.7-12 Data Traffic Assumptions

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General xDSL Data Traffic Assumptions		Defaults
Average Line Speed	The data rate of the xDSL line can be drastically impacted by the length, gauge, and if there are bridge taps or line repeaters in the loop. It is recommended that the customer actually measure the maximum transmission characteristics of the lines to be used to support their xDSL service with the applicable Customer Premise Equipment.	1 Mbps
Percent Active Lines	The percentage of lines that can be active (demanding BW) at the same time.	25%
PAR/ Overbooking Factor	A second factor is the concept of PAR (Peak to Average Ratio), sometimes referred to as the Overbooking Factor. This concept basically offers levels of restrictions based on the concentration (i.e., Concentration: 1 for Delay Sensitive Data, 10 for Delay Tolerant Data)	10

The following formula can be used for simple bandwidth calculations:
BW = (ADSL Lines * Ave. ADSL Line Speed * %Active / OB Factor) +
(SDSL Lines * Ave. SDSL Line Speed * %Active / OB Factor) +
(SHDSL Lines * Ave. SHDSL Line Speed * %Active / OB Factor)

A more detailed method of calculating bandwidth required is based on Quality of Service types. The QoS function prioritizes data traffic using the following 5 levels (highest to lowest):

- CBR (Constant Bit Rate)
- rt-VBR (real time-Variable Bit Rate)
- nrt-VBR (non real time - Variable Bit Rate)
- UBR (Unspecified Bit Rate)
- ABR (Available Bit Rate)

BW = (A + B + C + D + E) * % Active Lines

The variables A through E are defined as follows:

10.7.3.8 Physical Limitations

10.7.3.8.1 AIU Physical Limitations

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- The maximum PIDB/PICB cabling distance between the COMDAC and SM/SM-2000 TSI is 28 feet.

10.7.3.8.2 EAIU Physical Limitations

The maximum distance that the EAIU can be from the SM-2000 is determined by the following characteristics:

- Voice Quality (Echo Path Delay)
- Operational Limit (Control Message Delay)

Both the network components and signal propagation down the length of the transmission facilities contribute to the overall Round Trip Delay.

Assuming that the originating and terminating side of the call are the same, the approximate Round Trip Delays from the *5ESS*® switch components consists of the values shown in Table 10.7-13 .

Table 10.7-13 Component Delays

Component	Delay
EAIU AP	0.5 ms
RCOMDAC	0.25 ms
DLTU2/3 or DNU-S	0.25 ms.
SM-2000 TSI and CM	0.25 ms.
Total	**1.25 ms.**

The LSSGR specifies a maximum Echo Path Delay of 3.25 ms., leaving 2 ms. for any delay introduced by the transmission facilities.

- The maximum EAIU distance without echo cancellers is approximately 125 miles.
- If echo cancellers are used, the maximum EAIU distance is approximately 2,000 miles.
- The actual distance supported may vary, depending on the transmission equipment used.

10.7.3.8.3 XAIU Physical Limitations

- The maximum PCT cabling distance between the FCD and SM-2000 TSI is 2000 feet.
- The maximum length **difference** between the two PCT links terminating to the XAIU cabinet should not exceed 10 feet.

10.7.4 SYSTEM RESOURCE IMPACTS

10.7.4.1 TSI Engineering

- Each AIU PIDB will consume one DI/DX port.
- Each EAIU DS1 will consume one DX port if terminated via the DLTU2.
- Multiplexed EAIU DS1s terminated via the DNU-S or OIU will consume TSI ports for the PCT links.
- Each XAIU cabinet will consume either one or two TSI ports depending on the configuration selected.

Table 10.7-14 TSI Ports Required per XAIU Cabinet

XAIU Configuration	Shelves	TSI Ports
Low Traffic	6	1
Medium Traffic	4	1
	6	2
High Traffic	4	2

When two ports are required, one PLI is connected to a port on TSI side 0 while the second PLI is connected to a different port on TSI side 1. The corresponding port in the other service group can not be used for other applications.

Figure 10.7-10 XAIU PCT Connections

10.7.4.2 MH Enginering

Each mated pair of (Q/R)COMDACs will require two TSs on the same MH for call control.

10.7.4.3 Call Capacity

The AIU improves SM processor real time performance. A different line scanning technique is employed, along with other improvements, which reduce the SMP workload. Current estimates indicate that the real time improvement for the AIU (vs. LU3) is in approximately 20 percent.

10.7.4.4 EAIU Impacts on Other Units

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Figure 10.7-11 EAIU Termination Options

DLTU2

- The same DFI2s used for regular trunking applications are used for EAIU DS1s.
- DS1s carrying CTSs from the same EAIU must be on different DFI2s for reliability.
- DS1s from the same EAIU must terminate on the same SM-2000.

DNU-S

- All TS Groups from an EAIU must terminate on the same SM-2000.
- Primary/Control VT1 facilities from any single EAIU should be terminated on two different STSX-1 facilities whenever possible for reliability.

OIU

- The same OC-3 may be used to terminate multiplexed EAIU facilities.
- Since all facilities of an EAIU must terminate on the same SM, they may terminate on different OFI pairs provided that all the OFIs connect to the same SM.

10.7.5 ADMINISTRATION CONSIDERATIONS

10.7.5.1 Assignment Guidelines

10.7.5.1.1 Pack Assignments

Pack assignment considerations are summarized in Table 10.7-15

Table 10.7-15 Pack Assignment Considerations

Pack	Assignment Considerations
(Q/R)COMDAC	Two (Q/R)COMDAC packs are always required to support voice subscribers. These packs are not required in a data only DSLAM application.
AFM	The ATM Feeder Multiplexer (AFM) pack is required in AP slot 1 to support the data portion of the xDSL lines (if equipped). A second AFM may optionally be equipped in AP slot 1 if redundancy is required. The AFM packs are only supported on the shelf options with the Broadband Backplane.
RG	A pair of Ring Generator (RG) packs are required to provide power ringing to Analog subscriber/Coin lines (if equipped). Each RG takes up two slots and will be equipped in AP slots (17, 18, 19, 20) of the bottom shelf of a multi-shelf cabinet. These RG packs can support (via RG Bus Cables) up to three AIU shelves on the same side of the cabinet.
TAP	A Test Access Pack (TAP) is optionally equipped for remote EAIU applications that is beyond the MMSU metallic testing range of 3000 ohms and integrated testing with the rest of the *5ESS*® switch is desired. A single Test Access Pack can support up to 6 EAIUs within the same cabinet at a logical remote site as defined in ODD. Physical Design rules specify that the TAP can only be located in AP slot 16 of the lower front unit 23F.
AP	Any mix of Subscriber Line Applications Packs may be equipped in any available AP slot that isn't occupied by AFM, TAP, or RG packs. The xDSL packs are only supported on the shelf options with the Broadband Backplane. Any cross-connections required between the ADSL packs and POTS/ISDN packs in the same or other AIU shelf will be made at the Main Distribution Frame (MDF).

10.7.5.1.2 ISDN Assignments (AIU)

Any ISDN subscribers will require DPIDB pairs to the PSU, which will reduce the number of PIDBs that may be equipped.

- Up to 4 ISDN BRI D-Channels can be multiplexed into a single DPIDB TS, *provided all four are on the same ISDN AP and assigned to the same Protocol Handler in the PSU.* It is recommended to assign ISDN lines in groups of four from the same AP to the same PH (DSL Group). Otherwise additional TSs may be consumed by the D-Channels resulting in higher blocking or provisioning problems.
- Each ISDN PPB Channel will require 1 TS on the DPIDB.
- Additional DPIDB TSs will be required to support any ISDN On-Demand B (ODB) based on the estimated average traffic for this service.

The *5ESS*® switch can do automatic assignment of DPIDB Time slots. In order for this to occur, the pattern shown in Table 10.7-16 is assumed for D Channel assignments

Table 10.7-16 D-Channel Assignment Pattern

ISDN AP	Automatic DPIDB TS Assignments	Assignment Group
0, 4, 8, 12, 16	0, 4, 8, 12, 16, 20, 24, 28	X
1, 5, 9, 13, 17	1, 5, 9, 13, 17, 21, 25, 29	Y
2, 6, 10, 14, 18	2, 6, 10, 14, 18, 22, 26, 30	Z
3, 7, 11, 15, 19	3, 7, 11, 15, 19, 23, 27, 31	T

In analyzing the pattern, what should be observed is that a member of a particular Assignment Group has access to all of its group TSs on any equipped DPIDB. In other words, any pack that is a member of group "x" will have automatic access to any of the group "x" TSs that are available on any DPIDB. If APs 0 and 8 were assigned, and each AP had 16 customers (with no PPB), AP 0 would need 4 TSs and AP 8 would need 4 TSs, these could be accommodated on one DPIDB. AP 0 could access TSs 0, 4, 8, and 12; AP 8 could access TSs 16, 20, 24, and 28. Any PPB would be able to automatically access the group TSs on a DPIDB as well.

Where automatic assignment will fail is illustrated by the following scenario:

- 4 fully equipped 16-customer ISDN packs are installed as AP0 (group x), AP1 (group y), AP8 (group x), and AP16 (group x). One DPIDB is equipped based on 4 APs * 16 subscribers / 4 D-channels per TS / 32 TSs per DPIDB.

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- Automatic assignment will fail to assign D channels for customers on pack 16 since this pack expects to use the same TSs as AP0 and AP8 (group x).
- TSs are available from the pool automatically assigned to groups z and t. Customers on pack 16 will need to be manually assigned to these TSs.

10.7.5.1.3 ISDN Assignments (EAIU/XAIU)

- DPIDBs are not used for ISDN on the EAIU and XAIU.
- Up to 4 ISDN BRI D-Channels are multiplexed into a single DS1 channel (EAIU) or QPIDB TS (XAIU), *provided all four are on the same ISDN AP and assigned to the same Protocol Handler in the PSU.* It is recommended to assign ISDN lines in groups of four from the same AP to the same PH (DSL Group). Otherwise additional TSs may be consumed by the D-Channels resulting in higher blocking or provisioning problems.
- Each ISDN PPB channel will require 1 channel/TS.
- Additional channels/TSs will be required to support any ISDN On-Demand B (ODB) based on the estimated average traffic for this service.

10.7.5.2 Equipment Numbering

Equipment Numbering for the AIU is as follows:

AAA-BBB-CC-DD		
AAA	sm	SM number (001-192)
BBB	aiu	(E)AIU number (0-125)
CC	lp	Line Pack number (0-19)
DD	lc	Line Circuit number (0-31)

10.7.5.3 Traffic Measurements

The following Traffic Measurements are associated with the AIU:

Measurements	Report	Section
Access Interface Unit	TRFC30	216
AIU Lines	TRFC30	217
	TRFC30	218
AIU On-Demand B Channel Packet Switching	TRFC30	228
AIU PIDB/DPIDB	TRFC30	229

Refer to 235-600-750 *Output Messages Manual* for more information on these Traffic Reports.

10.7.5.4 Recent Change and Office Records

The following Recent Change Views, ODA Forms, and Office Records are associated with the AIU:

RC View	ODA Form	Office Record	Title
19.16	5745	5745	Access Interface Unit
19.23	5868	5868	XAIU PDXU
20.16	5746	5746	Access Interface Unit Pack

Refer to 235-080-100 *Translations Guide* and 235-080-100 *RC/V Manual* for more information.

10.7.6 OPERATIONAL SUPPORT SYSTEMS

10.7.7 TOOL REFERENCES

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Feature	TOPAZ Release
AIU/EAIU/XAIU	2
ESA on EAIU	5

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10.8 HIGH-LEVEL SERVICE CIRCUIT

10.8.1 DESCRIPTION

The high-level service circuits (HLSCs) reside in the line units (LUs) and integrated services LUs (ISLUs). An LU contains four, five, or six HLSCs depending on engineering. These circuits perform short duration functions (250 ms) during call setup and disconnect such as:

- Originating and terminating calls
  - Power cross tests (outside)
  - False cross and ground test (inside)
  - Party test
  - Coin control
- Disconnecting calls
  - Restore verify (inside).

Additionally, these circuits perform power ringing operations on terminating calls. The ringing cycle is shown in Figure 10.8-1 , and the sequence of functions performed by the HLSC during a typical SM-to-SM call are shown in Figure 10.8-2 . Since only 2 seconds are required for ringing a given line during the 6-second cycle, the remaining time can be used to perform the other functions or to ring other lines. Six HLSCs can ring up to 18 lines (allowing for the silent interval) at the same time. Since the HLSC is a time-shared resource, call holding times from switches which have non-time-shared service circuits must be divided by three to properly calculate HLSC CCS for the *5ESS*® switch.

An ISLU equipped with analog Z-cards uses HLSCs for short duration functions only; ringing is provided by the ringing generator. The ISLUs with ISDN lines only (T- and U-cards) do not require HLSCs for these functions. However, an ISLU equipped with U-cards does require two HLSCs to perform high current tests on the U-card. ISLUs equipped with only T-cards do not require HLSCs.

10.8.2 ENGINEERING CONSIDERATIONS

The HLCSs are provisioned uniformly on the basis of four, five, or six per LU. They are used for short durations (500 ms) during call setup and for 2-second intervals admitting line access to Type I ringing. The HLSCs are time shared, ringing up to 18 lines simultaneously, three per HLSC. The high day projected capacity of six HLSCs at P.001 blocking is 86 CCS. These capacities are shown in Table 10.8-1 .

If these capacities are reached or exceeded, customers may experience excessive dial tone delay or be routed to reorder. The solution to this condition is to reduce the load on the LU or to add more HLSCs (if possible). Each LU is equipped with a minimum of four HLSCs; this is required due to the rapid decline in capacity in the event one HLSC is out of service. If an LU were equipped with only three HLSCs, and one went out of service, there would not be sufficient resources for power ringing.

Table 10.8-1 LU HLSC Capacities

0.05 percent OAM			0.1 percent HD		
HLSC			HLSC		
4	5	6	4	5	6
40	65	82	43	68	86

Table 10.8-2 provides the CCS capacities for ISLUs utilizing Z-cards.

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Since the HLSCs do not provide ringing for the ISLU, the CCS requirement will be significantly less than for the LU. Therefore the ISLU is equipped with from two to four HLSCs. The ISLU can be physically equipped with up to six HLSCs, allowing spares to be provided. An ISLU equipped with both Z- and U-cards does not require additional HLSCs for U-card testing.

Table 10.8-2 Z-Card HLSC Capacities (CCS)

HLSCs	0.1 PERCENT HD	0.05 PERCENT OAM
2	11.9	12.8
3	17.9	19.3
4	40.0	43.0

Section 8 of the TRFC30 report contains the HLSC data. The total usage measurement should be monitored to identify any groups approaching capacity. This section includes HLSC measurements for both the LU and the ISLU.

10.8.3 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

10.8.3.1 Short Job and Ringing Overflows and Total Usage

The short job and ringing overflows and total usage measurements are made for the HLSCs. These measurements, which are considered key service indicators, are found in Section 8 of the TRFC30 report. The short jobs are those line tests performed by the HLSC at origination, termination, and disconnect. The HLSC also performs ringing functions for lines. Multiple short job overflow counts may be made for any call that incurs an HLSC blocking.

The effects of HLSC overflows vary based on the function resulting in an overflow. The affects are as follows:

- Ringing overflows are recorded when an HLSC cannot be obtained to provide power ringing to the terminating line. Before the overflow is recorded, the ringing job is rescheduled to try again later (a few hundred milliseconds later). This usually results in a successful HLSC selection so that an overflow is not registered. If an overflow is registered, the call is routed to reorder as a lost call.

- Originating short job overflows result in call delays. Since all originations are queued, failure to obtain an HLSC results in an overflow, and the call remains queued while an attempt is made to select another HLSC. Multiple overflows occur as long as no HLSC is available. Further, if the delay lasts more than 3 seconds, a dial-tone delay is also recorded.

- Terminating short job (restore/verify) overflows are not service affecting. This job is deferrable, and in cases of heavy load, it is automatically eliminated to ensure HLSC availability for originating and ringing jobs.

10.8.3.2 Other Measurements

Other measurements in Section 8 of the TRFC30 report include a peg count of the number of times the HLSC is used and the total usage and maintenance usage. These measurements are made for each LU in each SM.

10.8.4 FEATURE IMPACT

PEGCT(8) register is incremented by 2 or 3 pegs per call: 1 peg for the originating caller, 1 or 2 pegs for the terminating party (1 for ringing and 1 for disconnect).The disconnect test is initiated if the call is answered. The usage register includes the measurement of allocated circuit usage.

10.8.5 TRANSITION IMPACT

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Since each LU contains dedicated HLSCs, the addition of new LUs automatically provides the additional HLSCs. Therefore, growth procedures have no impact on HLSCs. If an LU has less than six HLSCs installed and it is determined that additional HLSCs are required, the new circuits can be added without affecting the existing circuits. For details on this growth procedure, refer to the following documents:

- 235-105-231 - *Hardware Change Procedures*
- 235-118-XXX - *Recent Change Procedures*
- 235-600-30X - *Equipment Configuration Data*.

10.8.6 HIGH-LEVEL SERVICE CIRCUIT WORKSHEET

The worksheet shown in Figure 10.8-3 should be used to calculate the percent utilization of the HLSCs (total office) CCS (hundred call seconds) load today and at the end of period (EOP). If the office has mixed concentration ratios, each concentration ratio may have a different number of HLSCs installed; this would require separate calculations for each group and for the office total.

The following paragraphs identify the columns of the HLSC worksheet and describe the calculations required to complete the worksheet.

(A) ***HLSC Installed per LU:*** The number of HLSCs installed per LU. (If the switch was engineered with mixed concentration ratios, the number of HLSCs may change.) Obtain number from the switch. This number will be 4, 5, or 6 HLSCs per LU.

(B) ***Engineering Criteria:*** The engineering criteria used to determine equipment capacities.

(C) ***HLSC CCS Capacity per Line Unit:*** The stated CCS capacity for the number of HLSCs installed per LU. Obtain number from Table 10.8-1 .

(D) ***Number of LUs Equipped With 4, 5, or 6 HLSCs:*** The number of line units installed in the office per concentration ratio. Obtain the number from the switch or the TEO (telephone equipment order).

(E) ***Office HLSC CCS Capacity:*** The HLSC CCS capacity of the office.

HLSC CCS Capacity per LU *Column C*	□	LUs Equipped with4, 5, or 6 HLSCs*Column D*	=	Office HLSCCCS Capacity*Column E*

(F) ***CCS Usage Data Today - Main Station Demand:*** The main stations working in the switch today. Obtain the number from the current working terminal report.

(G) ***CCS Usage Data Today - CCS Demand:*** This is the CCS demand on HLSC today. This value may be read from the current office engineering data or calculated.

MS Demand *Column F*	□	CCS/MS Today *Column H*	=	CCS Demand Today *Column G*

(H) ***CCS Usage Data Today - CCS per Main Station:*** The HLSC CCS usage per main station of the office today. This figure can be taken from the current office engineering data.

CCS Demand Today *Column G* / MS Demand Today *Column F*	=	CCS/MS Demand Today *Column H*

(I) ***CCS Usage Data EOP - Main Station Demand:*** The main stations forecasted to be working in the switch at EOP, or the highest main station demand during the engineering period. Obtain the number from the office forecast terminal report.

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(J) ***CCS Usage Data EOP - CCS per Main Station:*** The HLSC CCS usage per main station at which the office is forecasted to be handling by EOP. Since main stations and CCS per main station may grow at different rates, projections of future demand for each must be made separately.

(K) ***CCS Usage Data EOP - CCS Demand:*** The CCS demand on HLSC at the EOP. To calculate:

MS Demand EOP *Column I*	x	CCS/MS Demand EOP *Column J*	=	CCS Demand EOP *Column K*

(L) ***Main Station Capacity - Today:*** The main station capacity that the HLSCs are capable of handling today, based on the current CCS per main station per HLSC.

Office HLSC CCS Capacity *Column E* / SSC/MS Today *Column H*	=	MS Capacity Today *Column L*

(M) ***Main Station Capacity - EOP:*** The main station capacity that the HLSCs are capable of handling at the EOP, based on the forecasted main station and CCS per main station per HLSC.

Office HLSC CCS Capacity *Column E* / CCS/MS Capacity EOP *Column J*	MS Capacity EOP =	*Column M*

(N) ***CCS Load Percent Utilization Today:*** The maximum utilization of the HLSC capacity that is being used today.

CCS Demand Today *Column G* / Office HLSC CCS Capacity *Column E*	□ 100 =	CCS Load Percent Utilization Today *Column N*

(O) ***CCS Load Percent Utilization - EOP:*** The maximum utilization of the HLSC during the period.

CCS Demand EOP *Column K* / Office HLSC CCS Capacity *Column E*	□ 100 =	CCS Load Percent Utilization EOP *Column O*

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Figure 10.8-1 High-Level Service Circuit Ringing Cycle

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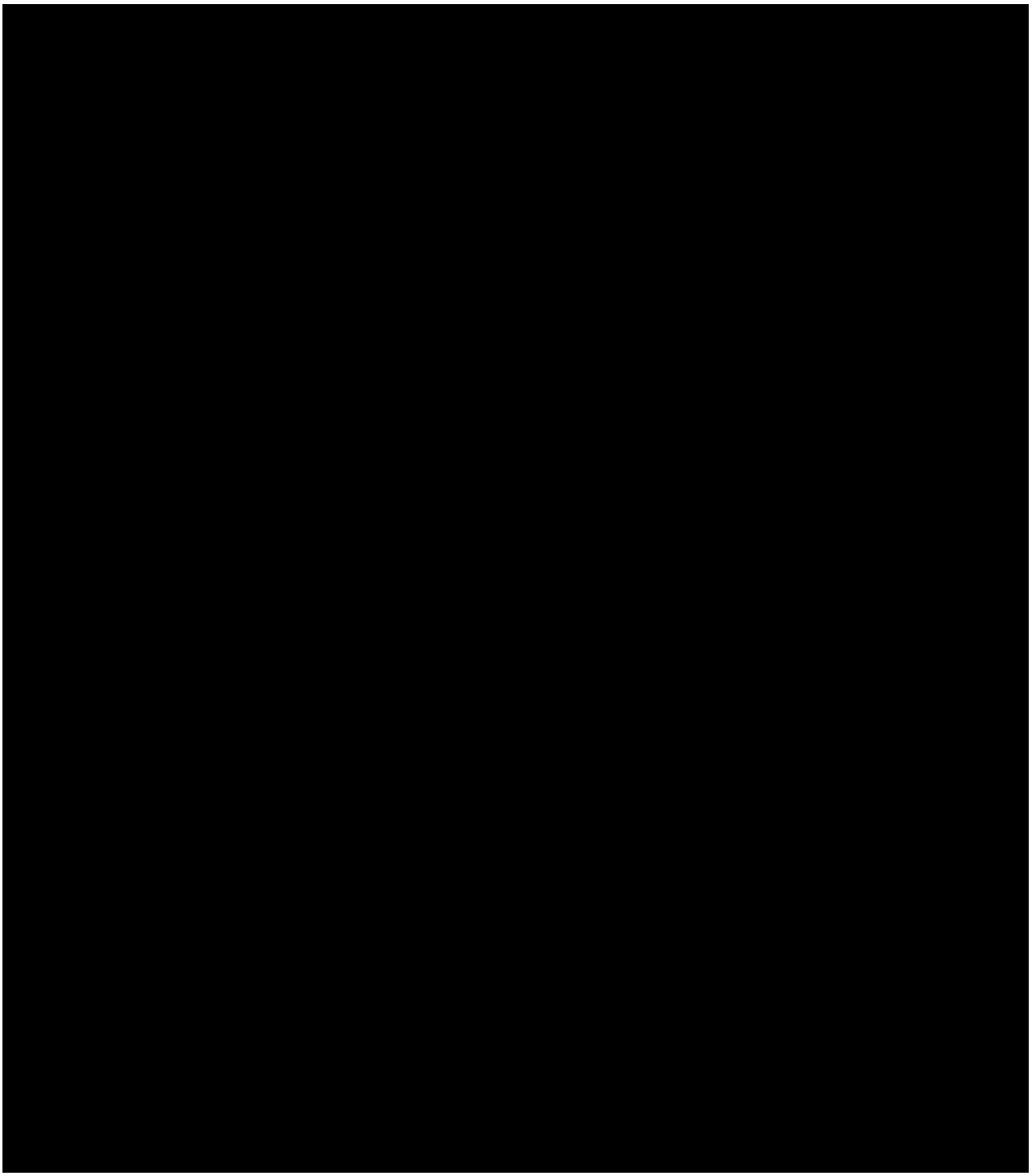

Figure 10.8-2 Sequence of HLSC Tasks

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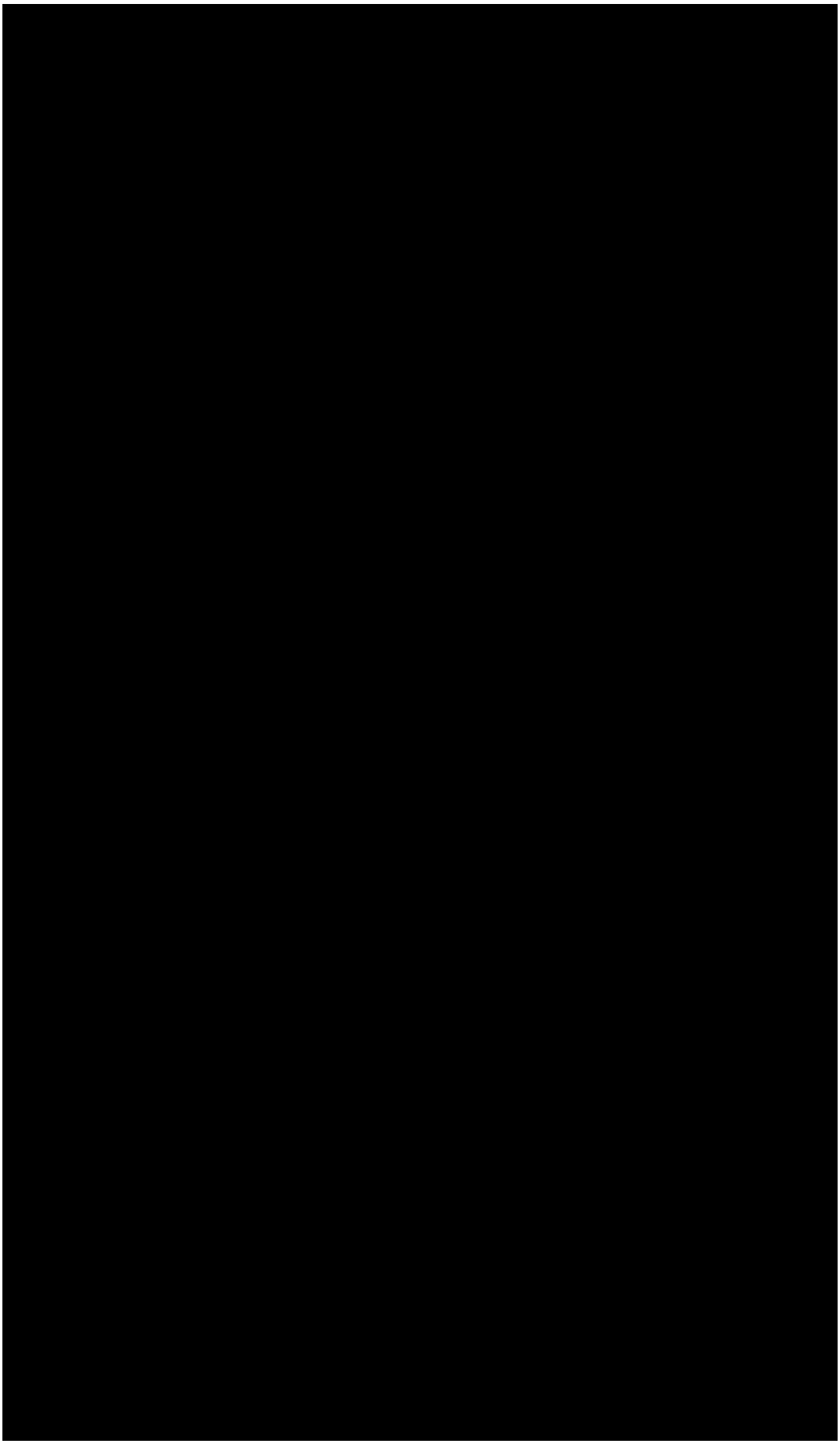

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Figure 10.8-3 High-Level Service Circuit Worksheet

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10.9 DIGITAL CARRIER LINE UNIT

10.9.1 INTRODUCTION

The *SLC*® 96 carrier system serves a group of up to 96 subscribers at a remote location. The system consists of the following: a *SLC*® 96 carrier remote terminal (RT) at the remote location, T1 transmission facilities (DS1-rate digital lines) between the RT and the *5ESS*® switch office, and a digital carrier line unit (DCLU) that connects the T1 facilities directly into the *5ESS*® switch. The *SLC*® 96 carrier system can serve single and multiparty lines, coin lines, and special service lines.

The *SLC*® 96 carrier RT terminates up to 96 analog customer lines at a remote location from the *5ESS*® switch. The function of the RT is to perform analog to digital conversion of the 96 customer lines and to multiplex them onto the equipped DS1 digital lines which terminate at the DCLU.

A *SLC*® 96 carrier system operating in Mode I (carrier only) provides no concentration at the RT, and provides 96 T1 line channels (24 channels per T1 line) to the *5ESS*® switch office via 5 T1 lines (4 active and 1 optional standby). A *SLC*® 96 carrier operating in Mode II (carrier concentrator) provides 2:1 digital concentration at the RT and provides 48 T1 line channels (24 channels per T1 line). The *SLC*® 96 carrier system operating in Mode III provides no concentration at the RT, and provides 48 dedicated 64 Kbps channels per RT over 48 time slots on 3 DS1 rate digital lines (2 active plus 1 protection line). The DCLU does not support RTs operating in Mode III.

The following types of customer lines can be served by the *5ESS*® switch via the *SLC*® 96 carrier remote terminals:

- Single-party lines using loop signaling
- Two-party lines (including operator number identification and automatic number identification)
- Eight-party lines
- Special service lines [wide area telephone service (WATS) lines, nondirect inward dialing, direct inward dial (DID) and private branch exchange (PBX) trunks].

10.9.1.1 General Description

The DCLU is a peripheral unit of the *5ESS*® switch and provides direct interfaces to digital facilities (T1 carrier lines) and to *SLC*® 96 carrier remote terminals. This capability eliminates the need for the *SLC*® 96 carrier central office terminal (COT); thereby saving the expense and space required for this equipment. The functions provided by the COT have been integrated into the DCLU for the *5ESS*® switch. The DS1 digital carrier lines from the *SLC*® 96 carrier system RTs connect directly through the main distributing frame (MDF), office repeater bay (ORB), and digital signal cross connect (DSX) bay to terminate on the specially designed DCLU. Within the DCLU, each DS1 (1.544 MB/sec) line terminates on a subscriber digital facility interface (SDFI). The connections between the DCLU and the *SLC*® 96 carrier RT are shown in Figure 10.9-1 .

The T1 lines terminating on the DCLU may be from *SLC*® 96 carriers operating in an unconcentrated mode (Mode I) or a concentrated mode (Mode II). A *SLC*® 96 carrier operating in Mode I employs five T1 lines (four active and one standby) while operation in Mode II employs three T1 lines (two active and one standby). One DCLU can terminate T1 lines from up to six *SLC*® 96 carrier remote terminals.

10.9.1.2 DCLU Topology

The DCLU consists of two service groups (SGs). Each SG multiplexes up to 15 T1 lines (12 active and 3

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standby) from up to 6 *SLC*® 96 carrier remote terminals onto 1 or 2 peripheral interface data buses (PIDBs). Figure 10.9-2 provides a block diagram of the DCLU. Each SG operates independently except during a failure mode or during call overflow. During either of these two events, another SG may process time slots from the affected SG. If one SG fails, the working SG carries traffic for both SGs at a reduced service level. Depending on the number of RTs and working lines per RT, the concentration varies as shown in Tables 10.9-1 and 10.9-2 . The maximum concentration ratio for Mode II operation is 9:1, and the maximum concentration ratio for Mode I operation is 4.5:1.

Each T1 line from a *SLC*® 96 carrier is terminated at the *5ESS*® switch by an SDFI which provides functions unique to the *SLC*® 96 carrier application.

10.9.1.3 DCLU Nail-Up Capability

The DCLU also has a "nail-up" capability. The ability to interconnect or "nail-up" DS0 ports between the DCLU and the digital line trunk unit (DTLU) peripheral units is provided as part of the 5E4 software release. A nailed-up circuit is similar to a stable switched call, except that the *5ESS*® switch allows in-band signaling to pass through unaltered. Nailed-up calls are not disconnected when a phone goes on-hook or as a result of any other station activity. Nail-up requires no external hardware, but its use reduces the number of available network paths. Nail-up circuits are established via recent change/verify (RC/V) assignments within the *5ESS*® switch data base. In the 5E4 software release, the *5ESS*® switch supports the following types of nail-up:

- DCLU to DCLU
- DCLU to DLTU.

Figure 10.9-3 shows some of the various ways that circuit nail-up can be implemented.

The majority of special services that can be nailed-up fall into three categories:

- Off-premises station
- Private line data
- Foreign exchange.

One type of nail-up circuit is for off-premises station, a completely nonswitched circuit (Figure 10.9-3 , sheet 1) which may be intraoffice or interoffice. There are also a large variety of foreign exchange circuits that may be nailed-up through the DLTU as shown in Figure 10.9-3 , sheet 2. Various other types of nail-up applications are shown in Figure 10.9-3 , sheet 3.

10.9.2 ENGINEERING CAPABILITIES

The DCLU provides the direct interface between *SLC*® 96 carrier Mode I and/or Mode II remote terminals and the *5ESS*® switch. The DCLU is composed of two SGs. Each DCLU multiplexes the T1 lines from up to six *SLC*® 96 carrier remote RTs onto two or four PIDBs for a maximum line concentration ratio of 9:1 or 4.5:1, respectively. The amount of concentration, a function of both the number of RTs and PIDBs per DCLU, is determined from Tables 10.9-1 and 10.9-2 . Note that this concentration is the total concentration including the 2:1 concentration at the *SLC*® 96 Mode II RT.

Table 10.9-1 DCLU Equipment Capacity per Hour - Mode I

BLOCKING CRITERIA [a]						TOTAL	CONC. RATIO	NO. LINES	DCLU TSS	DCLU TS	RTs
1.5%		4%		7%							
CCS/ LINE	TOTAL	CCS/ LINE	TOTAL	CCS/ LINE	TOTAL						

LINE	CCS		CCS	LINE	CCS	SDFI 4 ACT. 1 STBY					
3.19	1,837	3.41	1,964	3.53	2,033	30	9	576	1	64	6
3.83	1,838	4.08	1,958	4.24	2,035	25	7.5	480	1	64	5
4.79	1,839	5.10	1,958	5.30	2,035	20	6	384	1	64	4
6.93	3,992	7.25	4,176	7.44	4,285	30	4.5	576	2	128	6
8.31	3,989	8.69	4,176	8.92	4,285	25	3.75	480	2	128	5
10.36	3,978	10.85	4,166	11.14	4,278	20	3	384	2	128	4
13.78	3,969	14.43	4,156	14.8	4,265	15	2.25	288	2	128	3
20.56	3,947	21.54	4,136	22.12	4,247	10	1.5	192	2	128	2

Notes:

a. [a] .

Capacities assume 100% fill.

Table 10.9-2 DCLU Equipment Capacity per Hour - Mode II

BLOCKING CRITERIA [a]						TOTAL SDFI 4 ACT. 1 STBY.	CONC. RATIO	NO. LINES	DCLU TSS	DCLU TS	RTs
1.5%		4%		7%							
CCS/ LINE	TOTAL CCS	CCS/ LINE	TOTAL CCS	CCS/ LINE	TOTAL CCS						
3.06	1,763	3.27	1,883	3.40	1,958	18	9	576	1	64	6
3.65	1,752	3.90	1,872	4.09	1,963	15	7.5	480	1	64	5
4.52	1,736	4.83	1,855	5.04	1,935	12	6	384	1	64	4
6.61	3,807	6.93	3,992	7.13	4,107	18	4.5	576	2	128	6
7.83	3,758	8.21	3,941	8.45	4,056	15	3.75	480	2	128	5
9.51	3,652	10.0	3,840	10.32	3,963	12	3	384	2	128	4
10.02	2,886	11.07	3,188	11.7	3,375	9	2.25	288	2	128	3
□	□	□	□	□	□	□	1.5	192	2	128	2

Notes:

a. Capacities assume 100% fill.

The lower CCS per line of the Mode II loading reflects the 2-stage concentration provided by a 2:1 concentration at the RT coupled with the additional concentration at the DCLU. When mixing remote terminals of both modes in the same DCLU, the more conservative Mode II loading guidelines should be used. This is recommended to provide equitable service to both Mode I and Mode II RT customers.

10.9.3 ASSIGNMENT GUIDELINES

10.9.3.1 Estimating CCS Usage for *SLC*® 96 Carrier Remote Terminals

Before remote terminals can be assigned to DCLUs, the hundred call seconds (CCS) usage at each individual remote terminal should be estimated. This is necessary to ensure that the load presented by the remote terminals can be spread across the DCLUs as evenly as possible. The following formula can be used for that purpose:

CCS usage at RT = A □ B

Where:

A = number of lines terminating at RT at peak of engineering period

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B = CCS usage per line at peak of engineering period.

Notice that the CCS usage estimated for the RT is the peak-of-engineering-period usage (typically occurring at the end of the engineering period) since the values used for the number of lines and the CCS usage per line correspond to that time.

10.9.3.2 Assigning Remote Terminals to DCLUs

Each termination on the DCLU has an associated subscriber loop equipment number (SLEN). The SLEN number breaks down as follows:
SMN D R CN

Where:

SMN = Switching Module Number (1-192)

D = DCLU Number (0-7)

R = Remote Terminal Number (1-6)

CN = Channel Number (1-96).

The following procedure describes how the RTs in a *5ESS*® switch office can be assigned to the DCLUs in the office. In this procedure, the number of RTs in the office is *m* and the number of DCLUs is *n*.

- First, estimate the remote terminal CCS (RTCCS) value for each RT according to the preceding formula.
- Rank order the RTCCS values labeling the highest RTCCS as RTCCS(1); the next highest value RTCCS as RTCCS(2); etc., the lowest valued RTCCS(*m*). In this rank order, equal RTCCS values may be arbitrarily assigned as long as they are assigned sequentially.
- Number the DCLUs as DCLU(1), DCLU(2),..., DCLU(*n*).
- Assign the remote terminal with RTCCS(1) to DCLU(1), the remote terminal with RTCCS(2) to DCLU(2), etc., RTCCS(*n*) to DCLU(*n*). At this point, all DCLUs have a single RT assigned to it. Continue the assignment process by assigning the highest valued RTCCS to the DCLU with the most available capacity until all RTs have been assigned. This assignment procedure spreads the CCS load across the DCLUs as evenly as possible.

In some instances, it may be possible to obtain a better balance in total CCS assigned to DCLUs by selective switches of RT assignments. The administrator is encouraged to "fine-tune" the assignments whenever possible.

10.9.3.3 Switching DCLU Assignments

It is possible that an RT DCLU may exceed its capacity. In that situation, it may be appropriate to move one or more RTs to other DCLUs. Care should be taken to insure the new DCLU has sufficient capacity to handle the moved RTs. The RT transferring procedure given below is applicable for DCLUs engineered

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for Mode I RTs, Mode II RTs, or for a mixture of the two. Note that the following steps (1 through 4) are done off-line:

(1) Grow (define in office data base) DCLU if it does not already exist.

(2) Grow DFIs.

(3) Grow RT to be transferred in Step 1.

(4) Create batch file of line equipment numbers (LENs) to be transferred.

(5) During off-busy hours, execute batch file and move T1 lines at the DSX bay.

After the new assignment is completed, it is important to verify that the DCLU CCS capacity has not been exceeded. Additionally, if the RTCCS values change beyond expectation, it may be necessary to move the RT in question to another DCLU.

10.9.3.4 DCLU Nail-Up Circuit Assignment

Nail-up of circuits through the *5ESS*® switch requires that certain relevant data about special service circuits be recorded. This includes port appearances, channel unit types, facilities used and provisioning coefficients. This information is needed for numerous reasons including: tracking of facility utilization, making circuit changes, troubleshooting, and maintenance purposes. Port information can be accessed internally via OP:NAILUP message. (Refer to *Input message Manual* 235-600-700 for details concerning the OP:NAILUP message.) In addition to record keeping, nailed-up circuits need to be monitored for traffic administration. The number of nailed-up circuits per DCLU and SM must be carefully watched to maintain proper load balance and operational economy. No more than 25 percent of available time slots on a DCLU, or SM should be used for nail-up circuits. One of the simplest methods for traffic administration is to maintain a given fixed concentration ratio. For example, assume that the desired concentration ratio is 8:1 on a DCLU and that one port of a nail-up circuit passes through the DCLU. To maintain the 8:1 concentration ratio, the number of switched circuits on the DCLU must be reduced by 7 every time a circuit is nailed up. If both ports of a nail-up circuit terminate on the DCLU, the number of switched circuits must be reduced by 14.

10.9.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Section 20 of the TRFC30 report provides traffic usage measurements per *SLC*® 96 carrier remote terminal. Additionally, Section 21 of the TRFC30 report provides measurements on a per-DCLU basis. Refer to Appendix 1 of this manual for descriptions of these measurements.

Part 9 of the 24-hour plant report provides an ISMNAIL AUTO measurement which provides a count of the number of inter-SM nail-up restorations.

The key service indicator for the DCLU is the percentage of terminating calls blocked. This requires a calculation based on the number of calls blocked (TERMBLK) and total number of attempts (TERMATT). These measurements are found in Section 21 of the TRFC30 report. The calculation is:

10.9.5 FEATURE IMPACT

The subscribers connected to the *SLC*® 96 carrier RT have access to the same features as subscribers connected directly to the *5ESS*® switch. The assignment of features to the RT lines have no impact on the *5ESS*® switch other than the possible need for additional memory.

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10.9.6 TRANSITION IMPACT

Whenever changes are made to the channel units or the RTs, these changes must be reflected in the *5ESS*® switch data base. Changes are entered via the RC/V facility. The types of growth procedures associated with DCLU and *SLC*® 96 carrier services are as follows:

(1) RT growth

(2) Channel unit growth

(3) Moving a DS1 line between subscriber digital facility interfaces (SDFIs)

(4) Transfer of an RT from one DCLU to another

(5) Mode change of an RT

(6) Transfer an RT from LU to DCLU

(7) Transfer subscribers from cable to RT on DCLU

(8) Cutover from another office (COT to DCLU)

(9) Cutover from an analog CO to COT on a *5ESS*® switch

(10) Growth of universal *SLC*® 96 carrier systems on a *5ESS*® switch.

The first two procedures cover all hardware growth via the RC/V procedures and provide the basis for all the other procedures. The RC/V procedures required for making these changes are found in the *Recent Change Procedures Manuals* - 235-118-XXX.

Procedures 3, 4, and 5 are all rearrangements strictly from integrated *SLC*® 96 carrier system to integrated *SLC*® 96 carrier systems and involve growing and degrowing of RTs, SDFIs, as well as hardware modifications. Procedures 6 and 7 involve rearrangements on the *5ESS*® switch which result in the use of an integrated *SLC*® 96 carrier system arrangement. The remaining procedures involve either two different switches or two different offices. For details concerning the growth procedures, refer to 235-105-23X - *Hardware Change Procedures*; for details related to cutover procedures, refer to 235-105-200 - *Precutover and Cutover Procedures*.

10.9.7 DIGITAL CARRIER LINE UNIT WORKSHEET

Capacity determination for DCLUs cannot be based on the following:

- The number of terminations
- The total of digital lines in the office
- The total office CCS (hundred call seconds) per digital line.

This is due to the outside plant looking at the RT (remote terminal) as a cable and pair facility. Further, some RTs may have all 96 positions working while others may have only 50 positions working. The only way to get accurate capacity values is to perform capacity determinations based on:

- The RT capacity of six
- Measured CCS capacity of each DCLU

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- Engineered CCS/line values.

The worksheet shown in Figure 10.9-4 assumes the engineered concentration ratio and the number of RTs for each concentration ratio will not change except when the engineering criteria is changed. This approach forces the equipment utilization to be performed on the DCLU.

The following paragraphs identify the columns of the DCLU worksheet and describe the calculations required to complete the worksheet:

(A) ***SM Number:*** The switching module ID number that serves this DCLU. Obtain this number from the switch or the TEO (telephone equipment number).

(B) ***DCLU Number:*** The DCLU ID number. Obtain this number from the switch or the TEO.

(C) ***Engineered Concentration Ratio:*** Obtain this number from the TEO.

(D) ***RTs per DCLU - Engineered Capacity:*** Obtain this number from the DCLU equipment capacity table.

(E) ***RTs per DCLU - Today:*** The number of RTs that are working in each DCLU. Obtain this information from the switch or the TEO.

(F) ***RTs per DCLU - EOP:*** The number of RTs forecasted to be in service at the end of the engineering period. Obtain this information from a *SLC*® 96 carrier forecast.

(G) ***DCLU Working Lines - Engineered Capacity:*** Obtain this number from the DCLU equipment capacity table. To Obtain this number, read the engineered concentration ratio from *Column C* into the table.

(H) ***DCLU Working Lines - Today:*** The number of DCLU lines working today. Obtain this number from the switch or the office data.

(I) ***DCLU Working Lines - EOP:*** The number of DCLU lines forecasted to be in service at the end of the engineering period. Obtain this number from the digital line forecast.

(J) ***CCS per DCLU - Engineered Capacity:*** The CCS capacity of the DCLU based on the DCLU equipment capacity table. To obtain this number, read the engineered concentration ratio from *Column C* of this worksheet into the table.

(K) ***CCS per DCLU - Today:*** The CCS usage figure at which this DCLU is operating today. Obtain this information from the office data.

(L) ***DCLU CCS per Line - Engineered Capacity:*** Obtain this number from the office forecast, or use the following equation:

$$\frac{\text{Engineered Capacity CCS per DCLU (Column J)}}{\text{Engineered Capacity (Column G)}} = \text{Engineered DCLU CCS per Line (Column L)}$$

(M) ***DCLU CCS per Line - Today:*** Obtain this number from the office data records or use the following equation:

$$\frac{\text{CCS per DCLU Today (Column K)}}{\text{DCLU Working Lines Today}} = \text{DCLU CCS per Line Today (Column M)}$$

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Column H

(N) ***Percent Utilization DCLU CCS - Today:*** To calculate this percentage:

CCS per DCLU Today *Column K* / Engineered Capacity CCS per DCLU *Column J*	□ 100 =	Percent Utilization DCLU CCS - Today *Column N*

(O) ***Percent Utilization DCLU CCS - EOP:*** Obtain number from the switch or calculate:

DCLU Lines EOP *Column I*	□	CCS per Line *Column L*		Percent Utilization DCLU CCS - EOP
DCLU Lines EOP *Column I* / Engineered Capacity CCS per DCLU *Column J*	x	CCS per Line *Column L*	□ 100 =	Percent Utilization DCLU CCS - EOP *Column O*

(P) ***Percent Utilization RT - Today:*** Calculate using the following equation:

RTs per DCLU - Today *Column E* / Engineered Capacity RTs per DCLU *Column D*	□ 100 =	Percent Utilization RTs - Today *Column P*

(Q) ***Percent Utilization RTs - EOP:*** Calculate using the following equation:

RTs per DCLU - EOP *Column F* / Engineered Capacity RTs per DCLU *Column D*	□ 100 =	Percent Utilization RTs - EOP *Column Q*

(R) ***Percent Utilization Lines - Today:*** To Calculate:

DCLU Working Lines - Today *Column H* / Engineered Capacity DCLU Working Lines *Column G*	□ 100 =	Percent Utilization Lines - Today *Column R*

(S) ***Percent Utilization Lines - EOP:*** Calculate using this formula:

DCLU Working Lines - EOP *Column J* / Engineered Capacity DCLU Working Lines *Column G*	□ 100 =	Percent Utilization Lines - EOP *Column S*

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Figure 10.9-1 Connections Between DCLU and SLC 96 Carrier Remote Terminal

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Figure 10.9-2 DCLU Block Diagram

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Figure 10.9-3 DCLU Nail-Up Applications

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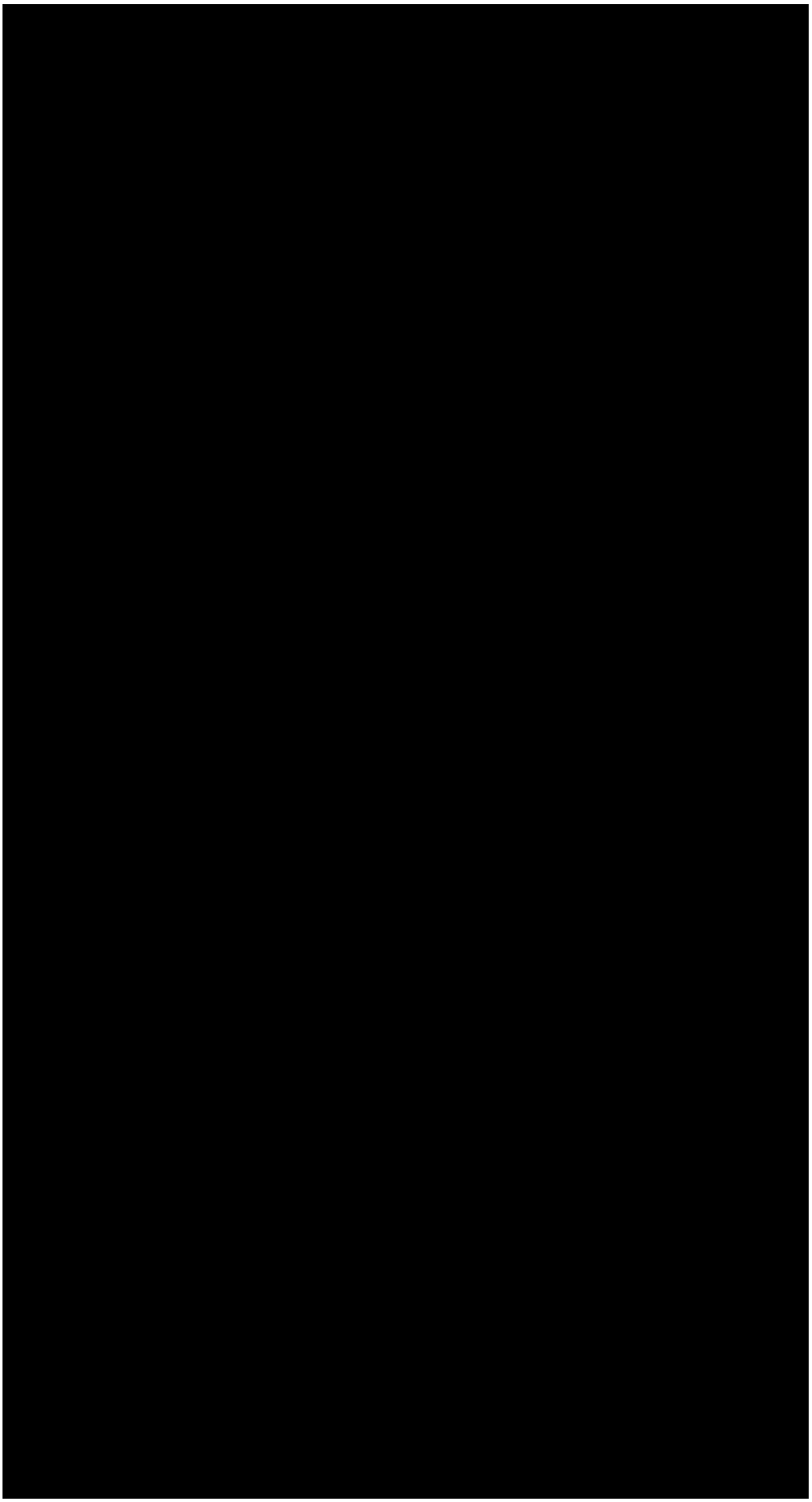

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Figure 10.9-4 Digital Carrier Line Unit Worksheet

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10.10 TRUNK UNIT

10.10.1 DESCRIPTION

The trunk unit (TU) provides for the termination of analog trunks. The TU provides termination capabilities for interoffice local or toll traffic, trunks to switchboards, operators, PBX direct inward dialing (DID), access from local test desk, and announcement machines. A TU provides up to 64 time slots and 64 trunk terminations. The number of TUs required is determined by the number of analog interexchange trunk terminations, plus one terminal for each announcement channel, two terminals for each local test desk test trunk, and two terminals per each local trunk and line work station (TLWS).

Each TU circuit pack has four trunk circuits (except those for test trunks which have two). Trunk circuits have been developed to provide an interface to the following nine multipurpose trunk types:

- Loop supervision, outgoing, 2-wire, local
- Loop supervision, outgoing, 2-wire, toll
- Loop supervision, incoming, 2-wire, local
- Loop supervision, incoming, 2-wire, toll
- E&M supervision, 2-wire, local
- E&M supervision, 2-wire, toll
- E&M supervision, 4-wire, local
- E&M supervision, 4-wire, toll
- Release link trunks (Centralized Attendant Services feature)
- Test trunk.

10.10.2 ENGINEERING CONSIDERATIONS

The TU provides 64 time slots and up to 64 trunk terminations. Some of these terminations may be used for announcement channels, local test desk trunks, and local TLWS terminations. The TU has 16 slots for TU circuit packs, with each circuit pack providing 4 trunk terminations (except for the test trunk circuit pack which provides 2 terminations). The TU provides no concentration. There is a time slot available for each trunk termination. Trunk members should be spread across trunk units for even distribution. Although there is no concentration, SM and AM/CMP real time is affected by trunk group assignment.

10.10.3 ASSIGNMENT GUIDELINES

Analog trunks served by a TU may be associated with trunk groups, carrier group alarm (CGA) groups, or other services independent of the placement within the switching modules (SMs). or reliability purposes, spreading of trunks serving the same or similar traffic may be desirable; however, this is not a system requirement.

Each termination on a TU has an associated terminal equipment number (TEN). This number is used in translations to locate and identify the particular trunk to which it is assigned. This TEN is composed as follows:
SMN T G P C

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Where:

SMN = Switching Module Number (0-192)

T = Trunk Unit Number (0-7)

G = Service Group (0-1)

P = Position (0-7)

C = Trunk Circuit (0-3)

10.10.3.1 Spreading Calls Among Trunk Groups

To better spread calls among trunk groups use the following guidelines:

- Divide the number of trunks in the trunk group by the number of TUs installed in the office. This provides the number of trunk group members per TU.
- Spread the members across all TUs evenly. Continue these assignments in this manner until all trunks are assigned

The use of these guidelines keeps the SMPU from overload due to excessive call volumes and spreads the trunk groups for service protection.

10.10.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

There are many sections of the TRFC30 report which contain measurements directly related to trunk traffic activity. These sections are listed below and described in detail in 235-600-750, *Output Messages Manual.*

- Section 5 - Call Type Information
- Section 12 - Trunk Group
- Section 24 - Inter-LATA Carriers - Tandem Trunks
- Section 55 - Queuing for Trunk Group Measures
- Section 56 - Trunk Group Queuing Announcement Measures
- Section 92 - Packet Switching Trunk Group

10.10.5 FEATURE IMPACT

The TU is not normally impacted by the use of features or the implementation of new features. If there are exceptions however, they will be described in the next paragraph(s).

10.10.6 TRANSITION IMPACT

Existing TUs are not impacted by growth procedures.

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10.10.7 TRUNK UNIT TERMINATIONS WORKSHEET

The following paragraphs identify the columns of the trunk units - terminations worksheet (Figure 10.10-1) and describe the calculations required to complete the worksheet:

(A) ***Installed Trunk Units:*** The total number of trunk units (TUs)installed in the office. Obtain this information from the switch, or telephone equipment order (TEO).

(B) ***Installed Circuit Pack Positions:*** The number of total circuit pack positions.

Installed Trunk Units *Column A*	□	Circuit Pack Positions Per TU (16)	=	Installed Circuit Pack Positons *Column B*

(C) ***Installed Test Packs:*** The number of test trunk circuit packs installed in the office. These packs will contain two trunks per pack. Obtain this number from the switch, or the TEO.

(D) ***Installed Trunk Pack Positions:*** The total number of available trunk circuit positions (four circuits per pack) that are in the office.

Installed Circuit Pack Positions *Column B*	-	Installed Test Pack Positions *Column C*	=	Installed Trunk Pack Positions *Column D*

(E) ***Office Trunk Capacity:*** The total number of trunks that the office has the capacity to terminate (four circuits per pack).

Installed Trunk Pack Positions *Column D*	□ 4 =	Office Trunk Capacity *Column E*

(F) ***Total Working Trunks Installed:*** The total number of working circuits (four per pack) in the office today. Obtain this number from the trunking records, or the switch.

(G) ***Available Spare Trunks:*** The total spare trunks in the office.

Office Trunk Capacity *Column E*	-	Total Working Circuits *Column*	=	Available Spare Trunks *Column G*

(H) ***Forecasted Trunks EOP:*** The total number of trunks forecasted for the end of the engineering period, or the peak analog trunks required during the engineering period including PBX-DID (private branch exchange - direct inward dialing) trunks. Obtain this number from the trunk forecast.

(I) Percent Utilization of Circuits Today: The percent of the analog trunks installed that is being used today.

Total Working Trunks *Column* / Office Trunk Capacity *Column E*	□ 100 =	Percent Utilization of Circuits Today *Column I*

(J) ***Percent Utilization of Circuits EOP:*** The percent of the analog trunks installed that will be used at the end of the engineering period.

Total Forecasted Trunks *Column H* / Office Trunk Capacity *Column E*	□ 100 =	Percent of Utilization of Circuits EOP *Column J*

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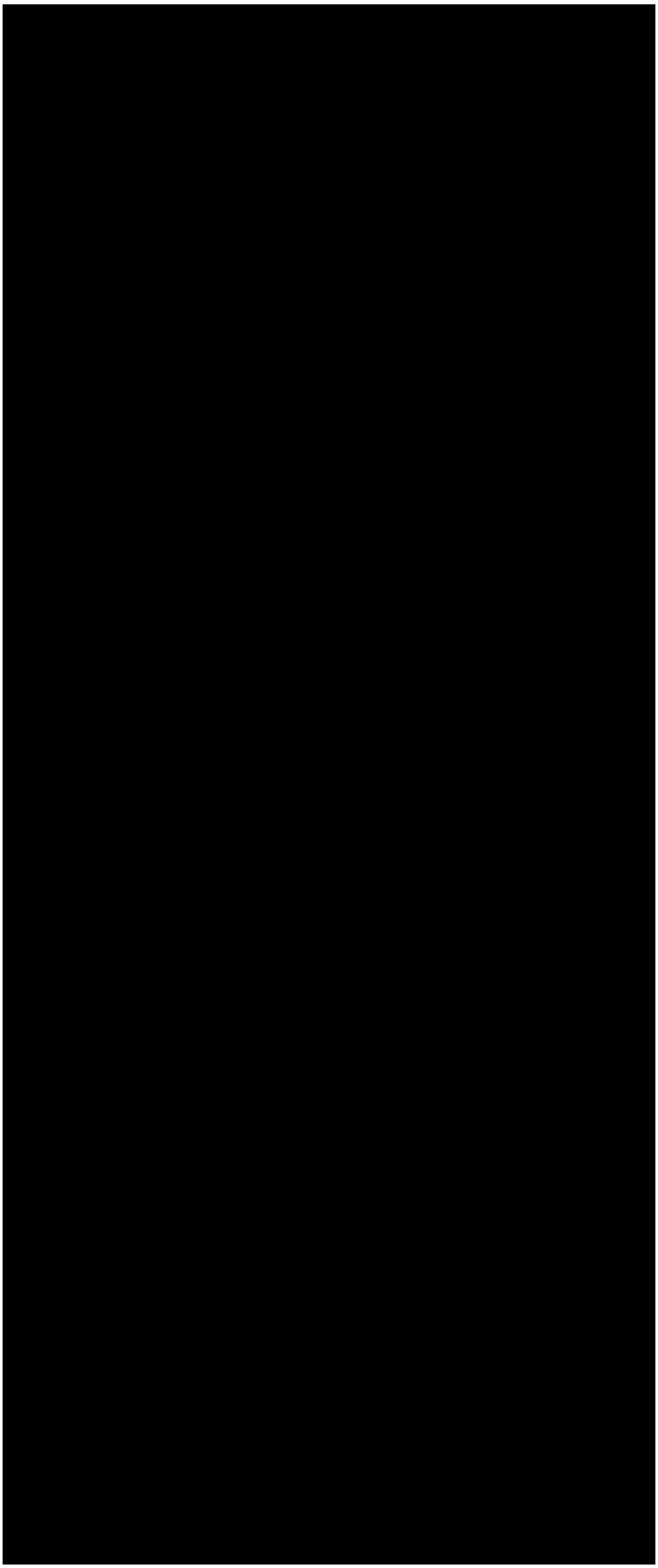

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Figure 10.10-1 Trunk Unit Terminations Worksheet

10.10.8 ANALOG TRUNK UNIT (ATU)

The Analog Trunk Unit (ATU) is needed on the SM-2000 to support the 13A Announcement interface, Trunk Testing interfaces, and other services provided by analog trunk units in the *5ESS*® switch Switching Modules. The ATUs on an SM-2000 provide the ability to port most features and peripherals from a *5ESS*®SM to the SM-2000. The ATU provides the same service to SMs and SM-2000, and will be transparent to the end user. The Analog Trunk Unit may terminate up to 64 metallic and analog carrier trunk circuits allocated between two service groups on a single equipment shelf.

10.10.8.1 Analog Trunk Unit Architecture

The Analog Trunk Unit (ATU), a peripheral unit in the *5ESS*® switch Switching Module, may terminate up to 64 metallic and analog carrier trunk circuits allocated between two service groups in a single shelf equipment, see Figure 10.10-2 . Each service group consists of four functional blocks - the trunk circuitry, control and data interface facility, test and access, and power supply. A service group can be equipped with its own appropriate set of trunk circuits, otherwise, the two service groups are identical.

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Figure 10.10-2 Analog Trunk Unit Block Diagram

The Analog Trunk Unit (ATU) has four hardware interfaces as follows:

- Two pairs of wires connect the distributing frame (D) to each trunk circuit.
- Two pairs of wires connect the Modular Metallic Service Unit (MMSU) to the ATU.
- -48 volts power feeders which connect the frame fuse panel to the ATU.
- The Peripheral Interface Data Bus (PIDB) and Peripheral Interface Control Bus (PICB) connect the ATU and the MCTSI, providing data transmission and synchronization and control.

See Figures 10.10-3 and 10.10-4 .

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Figure 10.10-3 ATU PIDB Interface to SM-2000

Figure 10.10-4 ATU PICB Interface to SM-2000

10.10.9 COMBINED SERVICES UNIT

10.10.9.1 Feature Overview

The following is a brief description of the CSU feature. The repackaging will combine functions of the DLTU, MMSU,DSU2-SAS and the GDSF in one shelf, thereby eliminating three backplanes (see Figure 10.10-5). The new shelf will be compatible with existing DLTU2, DSU2 and GDSU units in the same office

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and in the same SM or in different SMs. Although intended principally for the small site market, growth of these sites to more conventional office configurations necessitate that this unit and its global services be compatible with the same functionality provided by existing units.

An exception is made for the MMSU in the repackaged shelf feature. Similar to the remote MSU in RSM applications, the repackaged version will have only one service group, thereby making it incompatible with the standard MMSU which has two service groups. Therefore, if office growth to conventional configurations necessitate greater metallic services, the standard MMSU will need to be provided and the MMSU portion of the repackaged service circuit shelf will be degrown.

The MMSU portion of the CSU contains only a single service group. If a single SM office grows to a configuration requiring more extensive metallic services (two service groups), the standard MMSU will need to be provided and the MMSU portion of the CSU will be degrown.

If the office grows to more than one SM, it may retain the MMSU in the CSU unit. However, if there is a need to have two service groups in order to meet the need of expanded metallic services, a standard MMSU will have to be provided. This may be provided in a different SM than the SM containing the CSU/MMSU. There is no need to degrow the CSU/MMSU in this case; they are compatible.

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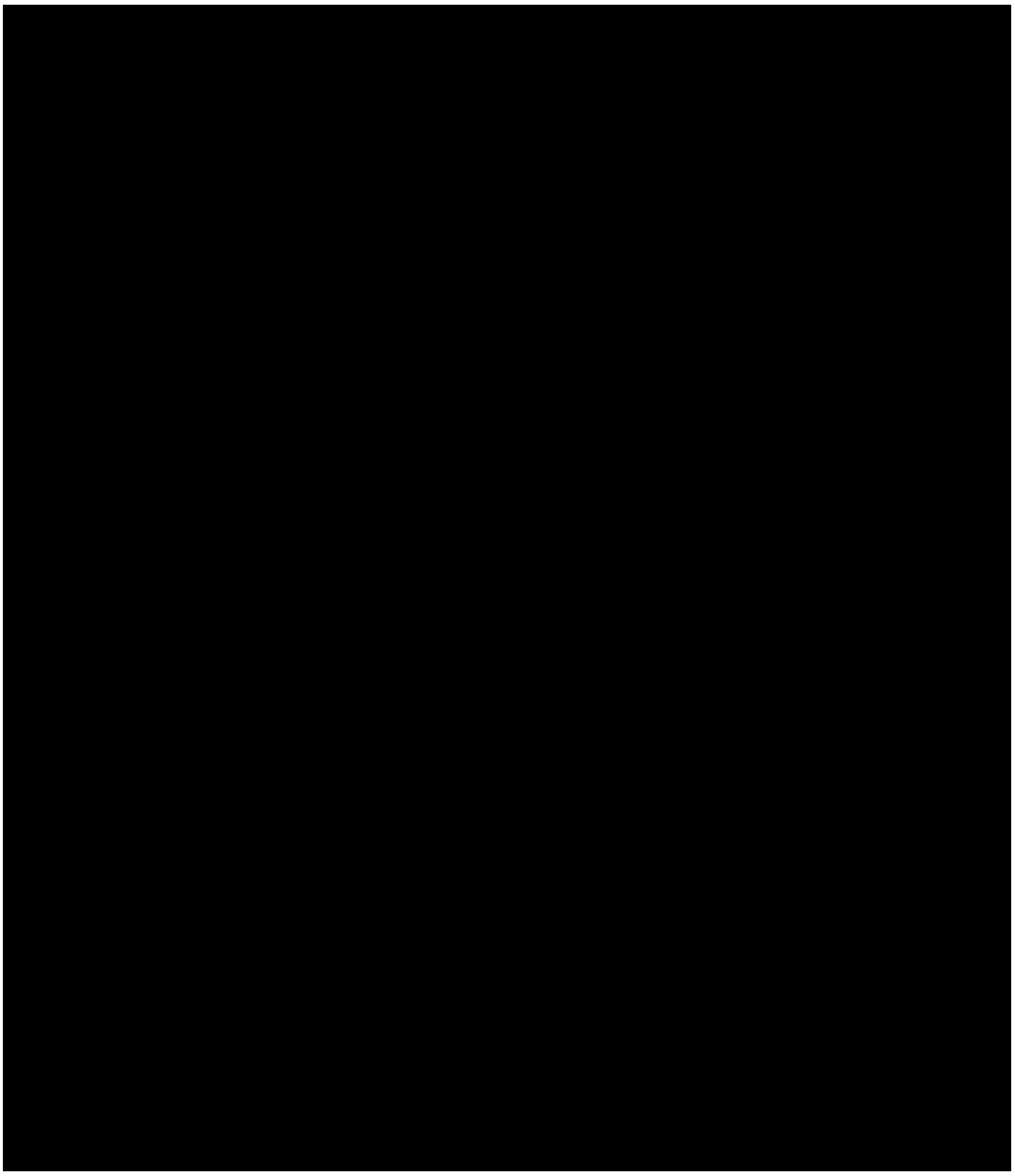

Figure 10.10-5 Typical Shelf Reduction

10.10.9.2 Combined Services Unit Dependencies

To realize the maximum benefit from this project, the new shelf design is predicated on the availability of: (1) the GDSF circuit pack and its TT, TT2, IST and conference circuit functionality, and (2) the SLIM circuit pack development. Both of these developments are targeted for the same release as this repackaged shelf. An office may still be engineered with the repackaged shelf to provide what may be available within the repackaged shelf and supplemented with other existing units to provide the necessary service functionality.

10.10.9.2.1 Service Provider Perspective

This unit will support up to five DFI2 type circuit packs for trunking purposes, one GDSF circuit pack arranged to provide trunk testing and conference circuit functionality, 250 seconds of RA capability, metallic testing by way of SLIM with optional compensator circuit pack and up to 64 scan points and 64 signal distribute points as shown in Figure 10.10-6 .

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Figure 10.10-6 Combined Services Unit

10.10.9.3 System Architectural Constraints and Impacts

The repackaging will combine functions of the DLTU2, MMSU, SAS and the GDSF in one shelf, thereby eliminating three backplanes. The new shelf will be compatible with existing DLTU2, DSU2-RAF, and GDSU units in the same office and in the same SM or in different SMs. This configuration is intended principally for the small site market, and growth of these sites to more conventional office configurations necessitate that this unit and its global services be compatible with the same functionality provided by existing units.

An exception is made for the MMSU in the repackaged service circuit shelf. Similar to the remote MSU in RSM applications, the repackaged version will have only one service group thereby making it incompatible with the standard MMSU which has two service groups. Therefore, if office growth to conventional configurations necessitate greater metallic services, the standard MMSU will need to be provided and the MMSU portion of the repackaged service circuit shelf will be degrown.

The MMSU portion of the CSU contains only a single service group. If a single SM office grows to a configuration requiring more extensive metallic services (two service groups), the standard MMSU will need to be provided and the MMSU portion of the CSU will be degrown.

If the office grows to more than one SM, it may retain the MMSU in the CSU unit. However, if there is a need to have two service groups in order to meet the need of expanded metallic services, a standard MMSU will have to be provided. This may be provided in a different SM than the SM containing the CSU/MMSU. There is no need to degrow the CSU/MMSU in this case; they are compatible.

10.10.10 TRUNK AND LINE WORKSTATION METALLIC TEST CAPABILITY

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This feature addresses the problem of providing an effective method of providing metallic (electrical) testing capabilities to maintenance personnel who use the Trunk and Line Workstation (TLWS) to do such testing.

10.10.10.1 Background

The Trunk and Line Workstation is a switch-based testing capability,

Currently, the metallic (electrical) test functions are provided to the TLWS capability by the Directly Connected Test Unit (DCTU), an electrical measuring device which provides the measurements for the TLWS capability. The DCTU provides a basic set of testing functions for the TLWS capability and an expanded set of functions which are used by the Integrated Mechanized Loop Testing (IMLT) System, an operations systems dedicated to line testing. The expanded set of tests, which are used by the IMLT system via an I/O port interface to the switch, include testing capabilities more detailed and sophisticated than the set provided for the TLWS user. (Unlike the TLWS interface, the IMLT system uses computer analysis to help interpret the results of the measurements.)

Currently, the switch also provides the Automatic Line Insulation Test (ALIT) capability which provides scheduled, automatic testing of lines. ALIT uses its own measurement hardware and switch software to test all analog lines in an office on a scheduled, periodic basis. The testing hardware is the ALIT pack.

Subscriber Line and Instrument Measurement (SLIM), is accessed via the TLWS video terminal. The terminal may be located at the switch location or remote from the switch. This feature provides a TLWS testing capability, which provides functions as nearly equivalent as possible to that provided by the existing DCTU-based testing capability, and provides functions similar to those now provided by the ALIT feature.

The TLWS testing functions which are currently provided by the DCTU-based TLWS feature and are provided by SLIM are listed below as follows:

- Voltage, resistance, and capacitance measurement
- Distance to Open measurement
- Coin phone testing - detect, collect, return coin; home totalizer
- Monitor for short function
- Send ROH
- Ring Line
- Perform all "line" tests on lines on Integrated Subscriber Loop Carrier systems.
- Cause trunk on hook, trunk off hook signals on trunks
- Add, drop, and change mode of Talk and Monitor phone

The following functions which are currently available at the TLWS are not provided by this feature:

- Ringer Count (The function is rarely used in the current telephone company environment)
- Perform "line" tests on lines on non-integrated Subscriber Loop Carrier systems (The function is not readily provided by the SLIM testing device).

This feature functions with the DCTU-based measurement system and the ALIT scheduled testing capability. Both DCTU and SLIM measurement systems may be employed in the same switch. The

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SLIM-based system will be used via a different TLWS display page than that currently used to do testing via the DCTU-based system. The scheduled testing capability provided by the SLIM feature will be controlled via different Recent Change views and parameters than those which control the ALIT feature.

The SLIM testing capability consists of the measurement hardware, the supporting software, and the technician interfaces to do line testing and display the results.

It is planned to equip all *5ESS*® switches with the software capability to support this feature as part of the TLWS feature. The actual implementation of the feature will require the purchase and installation of SLIM measurement devices.

The Routine Mode testing capability which is provided by this feature is a secured feature.

10.10.10.1.1 Feature Overview

10.10.10.1.1.1 General

This feature provides metallic (electrical) testing via the Trunk and Line Workstation interface. This feature is intended to be available either as an addition to or as an alternative to the TLWS metallic testing capability provided by the DCTU and ALIT testing capability.

In Operator Interactive Mode, or manual mode, the user accesses the electrical testing capabilities provided by this feature via a different display page on the TLWS terminal than that which accesses metallic testing provided by the DCTU. On an SM/SM-2000 with only this feature for metallic testing, the user would only use the display pages associated with this feature. Attempts to run tests that use the DCTU would not work. Similarly, on a SM/SM-2000 with only the DCTU testing capability, attempts to execute tests associated with the SLIM capability would not work. An SM/SM-2000 with both this feature and DCTU based testing will allow testing on either metallic testing page, selected by the user. The SM/SM-2000 will determine whether the DCTU-based testing capability and/or the SLIM based capability is available based on the testing hardware equipped in the SM/SM-2000.

The metallic access network, which is provisioned by the service provider, may be configured so that a specific line is accessible by only the DCTU testing device, only the SLIM testing device, or by either device. An attempt to use a testing device which cannot access the selected line or trunk, will fail and a display response will indicate the reason for failure.

The user will have access to a comparable set of testing capabilities on either the DCTU based TLWS pages or the SLIM based testing pages.

In Routine Mode, or automatic mode, this feature also provides a capability to set up and run a scheduled set of tests on analog lines. The user specifies the tests to be run, the thresholds which determine a pass/fail result, the lines to be tested, and the day and time the tests are to be run. The user defines the tests and the schedule by entering data via the Recent Change system. The scheduling capability can be provided in addition to the ALIT capability. In that case, it will be possible to run both scheduled line testing systems at the same time.

10.10.10.1.1.2 End-User Scenarios

A maintenance technician at the SM/SM-2000 site or at a remote location will be notified of a problem with a line or trunk. The technician will investigate that problem by various techniques. Most commonly, the technician will use the TLWS to determine the electrical characteristics of the line to assess the condition of the line and identify the source of the problem which was conveyed to the technician.

When the technician uses the TLWS to do the electrical testing, he or she may use the testing provided by this feature or the testing provided by the DCTU if both are available on the SM/SM-2000. This feature provides most of the TLWS capabilities which are provided by the DCTU, so the choice between the two testing systems (if both are available) will most likely be a matter of individual preference based on past

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experience with one or the other systems. The two systems provide similar electrical measurements with similar results. The TLWS pages and control procedures differ slightly.

10.10.10.1.2 Service Provider Perspective

10.10.10.1.2.1 Feature Overview

The service provider view of this feature consists of hardware modules which must be installed in the SM/SM-2000 and software which provides the TLWS pages by which the feature is used. The service provider determines the number of hardware modules to be installed to meet the testing needs of the switch.

10.10.10.1.2.2 Operational User

The testing systems engineer decides how many of the hardware modules to install and in which Modular Metallic Service Units(MMSUs) to install them. The service provider, who installs the hardware and configures the SM/SM-2000 data, would be a Recent Change technician or a switch maintenance technician.

10.10.10.1.2.3 Service Provider Scenarios

The service provider who equips this feature installs the testing units in the SM/SM-2000 by inserting SLIM hardware packs in the MMSU chassis after installation of the appropriate Metallic Test Bus network. The hardware packs are the instruments which actually make the electrical measurements and convey them to the TLWS software. The service provider must provision the switch data, via Recent Change, to indicate to the *5ESS*® switch where the SLIM units are located and how to communicate with them.

10.10.10.2 Network Impacts

10.10.10.2.1 Operations Systems Impacts

This feature does not directly interact with any operations systems, however, several systems could be impacted. Systems which are normally able to use Input/Output commands will have the ability to execute the new TLWS functions via the corresponding Input commands which are associated with all TLWS functions. Similarly, new output reports will occur to provide the results of this testing activity. The systems which have access to TLWS input and output messages are as follows:

- Total Network Management (TNM) system (formerly Switching Control Center System)
- TOPAS

The Recent Change activity associated with provisioning the feature would most likely be done by maintenance technicians, not by a provisioning OS. (The rationale is that this is a very special purpose, very infrequent provisioning task).

This feature does not provide an interface to the line testing OS, MLT. Service providers who intend to use MLT for line testing must either use non-integrated MLT, or must specifically choose and order the DCTU option in place of or in addition to this feature.

10.10.10.2.2 Feature Summary

This feature provides electrical testing capabilities via the Trunk and Line Work Station using the SLIM measurement system. This feature will provide the SLIM-based testing capability in addition to the existing DCTU-based testing on the SM/SM-2000.

This feature will implement the SLIM capabilities in the *5ESS*® switch by using the SLIM hardware, the

SLIM support software, and the SLIM TLWS display screens. This feature provides the following:

(1) Provide the "Operator" mode and "Routine" mode of the SLIM feature.

(2) Send "Receiver off Hook".

(3) Add, Drop, and control the Mode of the Talk and Monitor phone.

(4) Execute coin phone tests - detect coin, collect coin, return coin, and home totalizer.

(5) Monitor for Short.

(6) Modify the TLWS display screens to be consistent.

(7) Add the ability to test trunks from the SLIM TLWS display screens.

(8) Add the ability to test lines on Integrated Subscriber Loop Carrier (ISLC) systems, if the systems are implemented with bypass pairs for metallic testing and those pairs terminate on a Test Bus Control Unit (TBCU).

The ability to test lines on non-integrated *SLC*® systems, which is currently provided by the DCTU-based testing capability will not be provided by this feature. (This function would require hardware changes to the SLIM testing device which cannot be made at this time.)

The feature involves incorporating new hardware into the switch. The SLIM pack is designed to mount in the MMSU assembly. The SLIM pack is able to mount in any of the positions in the MMSU assembly which are normally available for application packs (16 positions per shelf). SLIM packs are supported in all SM types which can support an MMSU. This includes SM, RSM, ORM, SM-2000, EXM-2000. The SLIM packs interface to the *5ESS*® switch via the PICB control bus which serves the MMSU.

The MMSU(2) can be equipped in configurations of one to four shelves. Each shelf has 16 positions for packs, 8 positions in each of two service groups. (The common circuits which serve each shelf do not occupy any of the aforementioned 16 positions per shelf.) The maximum configuration has 32 positions in each of two service groups.

The SLIM packs connect to the metallic testing network via backplane connections. The connection via the backplane is different than the DCTU configuration. The DCTU is a separate peripheral whose ports connect to the metallic network via Metallic Test Buses (MTBs). Figure 10.10-7 illustrates typical access paths for a SLIM to Line Unit connection and for a DCTU to Line Unit connection.

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Figure 10.10-7 Metallic Access Network Connections

10.10.10.2.3 Interactions and Transparencies with Other Features

The SLIM-based testing feature in the *5ESS*® switch is an addition to the DCTU-based metallic testing feature and ALIT scheduled testing capability already provided. The DCTU-based testing capability will still be available and usable in a switch in which both DCTU and SLIM testing devices are equipped. The user may use SLIM-based testing or DCTU-based testing via selections made at the TLWS interface. The ALIT testing capability will still be available and usable in a switch which is so equipped. If both the SLIM and the DCTU-based testing features are implemented in the same switch, it is be possible to use both features. When multiple sources of testing activity are in progress simultaneously, access to a line, or to testing equipment is on a first come first served basis. If testing equipment is not available at the time of a test request, the request should be rejected. For interactive testing, the port to be tested must be manually seized via the existing TLWS pages for seizing ports, namely, pages 4000 and 4100. After the port is seized, it is possible to select the various pages which are available to perform tasks (for example "Transmission", "Supervision", "Metallic", and "Jacks") while the port is seized. The task selection options include both types of metallic testing pages (DCTU based or SLIM based). An indication of metallic testing

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functions which can be selected, based on whether the switch is equipped with both the DCTU and SLIM testing capabilities or only the DCTU or only the SLIM testing capability, is given. In addition to the marking, an attempt to select a function which is not equipped in the switch results in an explanatory error message.

10.10.10.3 System Architectural Constraints and Impacts

This feature is designed to fit into the existing switch architecture. The measurement hardware, the SLIM packs, are to be located into positions in the existing MMSU. The only constraints, which the existing architecture imposes are the total number of positions available in the MMSU and the number of metallic access paths available to connect a SLIM measurement unit to the metallic network. These constraints impact the feature but are not particularly unique to this feature.

MMSU positions are shared by several types of equipment, therefore, the number available for SLIM packs is dependent upon switch configuration decisions made by the service provider to meet the needs of a particular switch. It is estimated that the maximum configuration will meet the needs of large *5ESS*® switch configurations.

Similarly the number of metallic access paths available to the SLIM pack is limited by the inherent network configuration of the MMSU, primarily the backplane junctors for connecting each pack to other devices in the network. This limitation is identical to that encountered by the DCTU in which each port interconnects with other devices via the same backplane junctors. There are two engineering rules that are important when using the SLIMs for routine mode testing:

- Only ten concurrent routine mode session should be scheduled. If more then ten are scheduled for the same time, only ten will be run.
- Only two SLIMs per service group shelf is recommended if they are to be used for routine mode. This is necessary to eliminate metallic access junctor contention.

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10.11 DIGITAL LINE AND TRUNK UNIT

10.11.1 INTRODUCTION

10.11.1.1 DLTU

The digital line and trunk unit (DTLU) provides a direct interface between T1-carrier and the *5ESS*® switch and is devoted to two distinct functions: interoffice trunking and remote switching module (RSM) to host umbilicals. Each switching module (SM) may be equipped with a maximum of two fully loaded DLTUs. One DLTU has the capacity to terminate 10 T1 spans, each span requiring one digital facility interface (DFI) board. Each DFI is allocated 24 time slots, one per voice channel. A fully loaded DLTU consisting of 10 DFI boards is allocated four time slot sets (TSS), the equivalent of half of an SM.

The DLTU is mounted in the line trunk peripheral (LTP) cabinet and functions as the system interface for T1 carrier lines that operate at 1.544 MHz and carry 24 digital trunks. This arrangement eliminates the need for channel banks. The carrier facilities may be used for interoffice trunks, RSM umbilicals, or links between SMs of a multimodule RSM. Each SM may be equipped with a maximum of two DLTUs. A DLTU may contain ten DFIs. A DFI provides the following functions:

- Terminates digital trunks
- Converts between T1 carrier format and the data time-slot format
- Performs idle time-slot stuffing.

A DFI has a 32 time-slot peripheral interface data bus (PIDB) interface to the time-slot interchanger (TSI) and a peripheral interface control bus (PICB) interface to the control interface (CU). Each DFI terminates one T1 line. The T1 carrier has 24 channels of information multiplexed onto it.

In one direction a DFI distributes 24 channels onto a 32 time-slot PIDB by "stuffing" every fourth (idle) time slot. Four different patterns of "stuffed" time slots are required to stagger the arrival of idle time slots at the TSI. Each DFI is programmable into any of the four "stuffing patterns."

In the other direction, the DFI takes 24 of the 32 time slots from the PIDB and places them on a T1 carrier.

The DLTU may interface with a large number of existing digital transmission terminals (DTTs). These DTTs may be grouped into the following categories:

- ***Autonomous-Nonintelligent:*** These terminals have no local intelligence, but are capable of operating without control from the DLTU. Typical examples of autonomous-nonintelligent DTTs are:
  - D1D channel banks
  - D2 channel banks
  - D3 channel banks.

- ***Autonomous-Intelligent:*** These terminals operate under control of a local intelligence. When a DLTU interfaces a DTT in this category, coordination between the two is required. Typical examples of autonomous-intelligent DTTs are as follows:
  - 1 *ESS*™ switch digital carrier terminal
  - *4ESS*™ switch digital carrier frame
  - Another *5ESS*® switch DLTU

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- Digital access cross-connect and switch.

- ***Subordinate-Intelligent:*** These terminals have some local intelligence, and operate under direction from the SM processor. An example of a subordinate-intelligent DTT is the RSM.

In terminating T1 carrier to the system, standard cross-connections require an office repeater bay (ORB) and a digital cross-connect (DSX-1) span or frame. A T1 span enters the *5ESS*® switch through a DFI circuit pack mounted in the DLTU; DFIs (ANN 5) for RSM umbilicals, and DFIs (ANN 1 or ANN 3) for interoffice trunks.

10.11.1.2 DLTU2

The DLTU2 (digital line and trunk unit model 2), available beginning with software release 5E5, provides a direct interface between T1-carrier and the *5ESS*® switch devoted to two distinct functions: interoffice trunking and RSM-to-host umbilicals. Each SM may be equipped with a maximum of one fully loaded DLTU2. Each DLTU2 has the capacity to terminate 20 T1-spans. The DLTU2 is a 1-shelf unit having positions for 10 DFI2 circuit packs (2 circuits per pack). Each DFI2 circuit is allocated 24 time slots per circuit, one per voice channel. A fully loaded DLTU2 consists of 10 DFI2 boards and is allocated 8 TSSs, the equivalent of an SM. This makes 1 DLTU2, when it is equipped with 10 DFI2 packs, equal to 2 DLTUs fully equipped.

10.11.2 ENGINEERING CONSIDERATIONS

The DLTU provides direct interfaces to T1 digital facilities that serve as interoffice trunks or RSM umbilicals. The DLTU is equipped with circuit packs called DFIs which provide the direct interfaces. A different DFI circuit pack code is used depending on whether the interface is for interoffice trunks or RSM umbilicals.

Ten RSM umbilical DFIs may be reserved per DLTU to ensure that the maximum umbilical size of 20 T1 spans can be reached. All the umbilicals for an RSM must terminate on the same SM.

Each DLTU terminates up to ten 1.544 MB/s digital facilities with 24 channels each. A fully loaded DLTU (10 DFIs) uses 240 channels. A DLTU is engineered in multiples of 64 SM time slots. Each DFI terminates one digital trunk carrying traffic at the DS1 (1.544 MB/s) rate. A fully loaded DLTU with 10 DFIs is allocated 256 SM time slots.

In the case of an RSM umbilical, a single DLTU can provide connections for up to 256 time slots of the RSM network control and timing (NTI) link.

The method for engineering DLTUs is to allocate T1 lines in sets of eight or ten and provide one DLTU to mount the DFIs thus allocated. Fully loaded DLTUs (10 DFIs) are allocated 256 SM time slots. Partially loaded DLTUs are allocated sufficient SM time slots in sets of 64 to serve the T1 channels (for example, 8 DFIs in one DLTU require 192 time slots).

Refer to "Engineering Considerations" for "Fractional DS1 Switching" in the ISDN SOFTWARE UPDATES section to engineer an SM for wideband service. These engineering considerations apply to the three SM configurations:

- **Basic SM** supporting interoffice trunk terminations (digital trunks using ISUP signaling, not PRI) or in a tandem switching environment

- **Standard SM** also supporting interoffice trunk terminations (digital trunks using ISUP signaling, not PRI) or in a tandem switching environment

- **Loaded SM (ISDN)** supporting end-user PRI access.

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In each of these configurations, the NCT link occupancy must be controlled by leaving some time slots unoccupied. To determine the quantity of unoccupied time slots refer to the "Engineering Considerations" for "Fractional DS1 Switching" in the ISDN SOFTWARE UPDATES section.

10.11.2.1 DLTU

The general method for engineering a DLTU is to optimize the total number of SM TSSs required to serve the T1 lines and to allocate any remaining TSSs, unassigned in partially loaded DLTUs, to other interface units. Efficient allocation of TSSs generally results in fewer SMs.

If the *5ESS*® switch is predominantly a local (line) office, the most efficient utilization of time slots is to assign either three TSSs per DLTU (192 time slots for 192 T1 trunks or umbilical trunk); or if a paired DLTU is required, to assign six TSSs (384 time slots for 384 T1 trunks or umbilicals) for non-ISDN SMs.

The assignment of three TSSs per DLTU fully utilizes time slot resources. In the paired DLTU configuration, two TSSs are available for assignment to other units. Note that reserving time slots in the SMs containing the DLTU could be considered. One reason for this may be the anticipated growth of RSM umbilicals in the DLTU.

All umbilical trunks from an RSM must connect to the same host SM. The host SM can serve more than one RSM. If growth occurs in an RSM, and the host SM had its time slots fully allocated, the engineer would have to rehost the RSM umbilicals to another SM.

If the *5ESS*® switch is predominantly a toll office, the purpose of the DLTU engineering is to fully utilize equipment. One or two fully equipped DLTUs utilize four TSSs (256 time slots) or eight TSSs (512 time slots).

A fully equipped DLTU with 10 DFI circuits for either T1 trunks or umbilicals uses 240 time slots (24 time slots per T1 line or umbilical). The SM allocates four TSSs (256 time slots) on the peripheral side of the time slot interchange (TSI) to the DLTU which results in 16 time slots not being used. With two DLTUs in the SM (also called paired DLTU) 32 time slots are not used.

The basic approach used by the engineering rules is to take inputs derived by the traffic engineer, calculate equipment quantities, and through a series of warning messages indicate any potential for optimization. It is important to recognize that the engineering rules develop a working configuration. Warning messages only indicate that a situation exists which an engineer may wish to investigate further. They do not preempt engineering judgment, but do assist in making sound decisions. If the Digital Ordering and Planning System Module (DOPSMOD) does not generate any warning messages, the job should be considered optimum.

10.11.2.2 DLTU2

The general approach for engineering the DLTU2 is to optimize the total number of SM TSSs required to serve the T1-lines and to allocate any remaining TSSs, unassigned in partially loaded DLTU2s, to other interface units. Efficient allocation of TSSs generally results in fewer SMs.

If the *5ESS*® switch is predominantly a local (line) office, the most efficient use of time slots is to assign either 3 TSSs, (4 DFI2 circuit packs, 192 time slots) or to assign 6 TSSs, (8 DFI2 circuit packs, 384 time slots) per DLTU2 for non-ISDN SMs. For 5E5 and later software releases, DFI time slots may be recaptured for PSU nail-up time slots.

The assignment of 3 or 6 TSSs per DLTU2 fully uses time slot resources. Reserving time slots in the SMs containing the DLTU2 may be considered for anticipated growth of RSM umbilicals in the DLTU2. All umbilical trunks from an RSM must connect to the same host SM. The host SM can serve more than one RSM. If growth occurs in an RSM, and the host SM has fully allocated time slots, the RSM umbilicals must be rehosted to another SM. The host DLTU2 can terminate both umbilicals and trunks, but not on the

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same DFI2.

Each host DFI2 carrying a control time slot (CTS) from an RSM can have only one CTS assigned per circuit pack for each RSM. The other circuit on those DFI2s may be assigned as a CTS from another RSM. An RSM has 2 or 4 umbilicals carrying CTSs. These umbilicals must terminate in DFI2-R circuit pack positions 1 and 2, or in positions 1 through 4. The second circuit on these packs should not be used as CTS but can be assigned as umbilical. See Figure 10.11-1 .

If the *5ESS*® switch is predominantly a toll office, the purpose of the DLTU2 engineering is to use the equipment fully. One fully equipped DLTU2 uses 8 TSSs (512 time slots). A fully equipped DLTU2 having 10 DFI2 packs (2 circuits per pack) for either T1-trunks or umbilicals uses 480 time slots (24 time slots per T1-line or umbilical). The SM allocates 8 TSSs (512 time slots) on the peripheral side of the TSI to the DLTU2, resulting in 32 time slots not being used. Time slots not committed are available for nail-up time slot assignments at the PSU (software releases 5E5 and later). See Tables 10.11-1 and 10.11-2 .

Table 10.11-1 DFI Assignment Considerations

DFI GROUP SIZE	RESERVED DFI (a)	EXCESS DFI CAPACITY (b)	TSS	DFIs ASSIGNED		LOCKED OUT DFIs IN SMs WITH			
				IN 1ST DLTU	IN 2ND DLTU	0	1	2	3
						UNALLOCATED TSS (c)			
NONPAIRED DLTU (d)									
1	2	1	1	1	NA	8	5	2	0
2	2	0	1	2	NA	8	5	2	0
3	5	2	2	3	NA	5	2	0	0
4	5	1	2	4	NA	5	2	0	0
5	5	0	2	5	NA	5	2	0	0
6	6	2	3	6	NA	2	0	0	0
7	8	1	3	7	NA	2	0	0	0
8	8	0	3	8	NA	2	0	0	0
9	10	1	4	9	NA	0	0	0	0
10	10	0	4	10	NA	0	0	0	0
PAIRED DLTU (d)									
11	13	2	5	8	3	7	4	2	0
12	13	1	5	8	4	7	4	2	0
13	13	0	5	8	5	7	4	2	0
14	16	2	6	8	6	4	2	0	0
15	16	1	6	8	7	4	2	0	0
16	16	0	6	8	8	4	2	0	0
17	18	1	7	9	8	2	0	0	0
18	18	0	7	10	8	2	0	0	0
19	20	1	8	10	9	0	0	0	0
20	20	0	8	10	10	0	0	0	0

Notes:

a. Cabled DFI slots.

b. Excess capacity available for future plug-in growth. Except in rare cases, it is unreasonable to size DLTU TSS groups larger than the minimum sum of DFIs in a group to be assigned. This optimizes TSS.

c. Permanently unassignable DFI slots based on the quantity of TSS not assigned to other interface units.

d. Any DFI group larger than ten requires two DLTUs to be paired on an SM. Fewer SMs than DLTUs require the pairing of DLTUs.

Table 10.11-2 DFI2 Assignment Considerations

T1 GROUP	TS AVAILABLE FOR PSU NAIL-UP	TSS	DFI2 ASSIGNED IN DLTU2
1	8	0.5	1
2	16	1.0	1
3	24	1.5	2
4	0	1.5	2
5	8	2.0	3
6	16	2.5	3
7	24	3.0	4

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8	0	3.0	4
9	8	3.5	5
10	16	4.0	5
11	24	4.5	6
12	0	4.5	6
13	8	5.0	7
14	16	5.5	7
15	24	6.0	8
16	0	6.0	8
17	8	6.5	9
18	16	7.0	9
19	24	7.5	9
20	32	8.0	10

10.11.3 ASSIGNMENT GUIDELINES

The DLTUs are nonblocking and provide no concentration. Trunk members should be spread across all available DFIs for the best real time performance in the AM/CMP and SMP. The assignment of trunk groups throughout the DLTUs should be diversified whenever possible to ensure some degree of service in the event of a particular unit failure. This is especially true in the DLTU2 because of the additional T1s per DFI.

Each termination on the DLTU or DLTU2 has an associated digital equipment number (DEN). The DEN is composed as follows:
SMN D I CN

Where:

SMN = Switching Module Number (0-192)

D = DLTU Number (0-7)

I = DFI Number (1-10)

CN = Channel Number (1-48)

10.11.3.1 DLTU

All DFIs in one DLTU must be assigned to one data interface (DI). The DFIs may be assigned in groups. These groups are arbitrary groupings of T1 spans which may include both trunks, ICLs, and RSM umbilicals. However, group sizes greater than ten (five or more time-slot sets) always require two DLTUs to be paired on the same SM. Otherwise, two DLTUs are not assigned in the same SM unless there are more DLTUs than there are SMs. Group sizes greater than ten DFIs (four time-slot sets) should only be created when umbilicals from a single RSM require such a group size. Group sizes greater than eight should only be created when either an RSM umbilical group larger than ten exists, or a pure toll office situation exists. Table 10.11-1 provides DFI assignment considerations.

Those time-slot sets in an SM which are not required to serve DFIs may be assigned to other interface units (IUs). This assignment rule allows time-slot sets to be used efficiently and can sometimes save the cost of purchasing an additional SM. However, when time-slot sets are assigned to other IUs, they are no longer available for subsequent assignment to the DLTU. Those DFI locations on the DLTU become permanently unassignable because there are no time-slot sets available to serve them. Table 10.11-1 identifies the quantity of DFIs that are permanently unassignable based on the number of time-slot sets in an SM that are unallocated (not assigned to other IUs). Total time-slot demand in the office is minimized by decreasing the number of unassignable DFIs.

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10.11.3.2 DLTU2

The DFI2s in one DLTU2 can be assigned to two data interfaces (DI). The DFI2s may be assigned in groups. These groups include trunks, ICLs, and RSM umbilicals. Group sizes greater than four TSS can use the DLTU2 for an RSM umbilical group larger than ten umbilicals, or for a pure toll office. Table 10.11-2 provides DFI2 assignment considerations.

10.11.3.3 Spreading Calls Among Trunk Groups

To better spread calls among trunk groups use the following guidelines:

- Divide the number of trunks in the trunk group by 24 (24 trunks per DFI pack.)
- Spread the DFI packs across all possible DLTUs.
- Spread the trunk members across all DFI positions.
- Continue these assignments in this manner until all trunks are assigned.

The use of these guidelines keeps the SMPU from overload due to excessive call volumes and spreads the trunk groups for service protection.

10.11.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

There are many sections of the TRFC30 report which contain measurements directly related to DLTU traffic activity. These sections are listed as follows:

- Section 12 - Trunk Group
- Section 16 - Digital Line and Trunk Unit
- Section 24 - Inter-LATA Carriers - Tandem Trunks
- Section 55 - Queuing for Trunk Group Measures
- Section 56 - Trunk Group Queuing Announcement Measures
- Section 92 - Packet Switching Trunk Group

See the Primary Service Indicators and Measurement Threshold section for additional information.

10.11.5 TRANSITION IMPACT

As DFI circuit packs are added to directly interface with more T1 lines, they should be installed sequentially within a DLTU. Additionally, recent changes must be made to enter the data into the data base to assign the DLTU and the DFIs. For further information concerning this growth procedure, refer to the following documents:

- 235-118-XXX - *Recent Change Procedures*
- 235-105-230 - *Hardware Change Procedures*
- 235-600-300 - *Equipment Configuration Data Manual*.

10.11.6 STUFFING PATTERN

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When adding a DFI pack to a DLTU, the stuffing pattern must be correct or blockage will occur. Unidentified office blockage may be seen if the stuffing pattern is incorrect. The stuffing pattern (A, B, C, or D as shown in Table 10.11-3) is assigned for all new offices by Lucent Technologies. In an existing office, the stuffing pattern must be added by Recent Change at the time that the DFI pack is added to the office.

Table 10.11-3 Idle Time Slots

STUFFING PATTERN	IDLE TIME SLOTS							
A	0	4	8	12	16	20	24	28
B	1	5	9	13	17	21	25	29
C	2	6	10	14	18	22	26	30
D	3	7	11	15	19	23	27	31

Each DFI pack is assigned to a PIDB; the PIDB is assigned to a data interface (DI). Since a DFI pack has only 24 time slots and the PIDB has 32, eight time slots are unused (idle). A stuffing pattern is assigned to each DFI pack to handle the idle time slots. To prevent time slot blockage, the patterns must be spread equally over all working DFI packs in a DLTU.

10.11.7 DIGITAL LINE TRUNK UNIT TERMINATIONS WORKSHEET

10.11.7.1 DLTU

The following paragraphs identify the columns of the DLTU worksheets (Figures 10.11-2 and 10.11-3) and describe the calculations required to complete them.

(A) DLTU TSS: The DLTU available TSSs.

(B) DFI Packs per TSS: The number of DFI packs that may be installed per TSS.

(C) Installed DLTUs per TSS: The number of DLTUs installed in the office that were engineered at various TSSs. Obtain this information from the switch or TEO.

(D) Installed in DFI Positions: The number of DFI positions installed in this office. To calculate:

DFI Packs Per TSS	□	Installed DLTUs Per TSS	=	Installed DFI Positions
Column B		*Column C*		*Column D*

(E) Working DFIs per TSS: The total working DFIs per TSS. Obtain information from switch or TEO.

(F) Available Spare DFI Positions: The DFI positions not being used today. To calculate this number:

Installed DFI Positions	-	Working DFIs Per TSS	=	Available Spare DFI
Column E		*Column E*		Positions *Column F*

(G) Forecasted DS1 Inputs EOP: The total number of DS1 inputs forecasted to EOP, including RSM umbilicals. Enter only field for total.

(H) Percent Utilization of DFI - Today: The percent of the DFI packs installed that are being used today. Enter only in field for total.

Total Working DFI Packs Installed *Column E Total* / Total Installed DFI Positions *Column D*	□ 100 =	Percent Utilization of DFI - Today *Column H*

(I) Percent Utilization of DFI - EOP: The percent of the DFI packs installed that will be used at the end of this engineering period. Enter only in field for total.

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Forecasted DS1 Inputs EOP *Column G* _____ Total Installed DFI *Column D*	□ 100 =	Percent Utilization of DFI - EOP *Column I*

10.11.7.2 DLTU2

The following paragraphs identify the columns of the DLTU2 worksheet (Figure 10.11-2) and describe the calculations required to complete the worksheet.

(A) DLTU2 TSS: The DLTU2 available TSSs.

(B) DFI-2 Packs per TSS: The number of DFI-2 packs that may be installed per TSS.

(C) Installed DLTU2s per TSS: The number of DLTU2s installed in the office that were engineered at various TSSs. Obtain this information from the switch or TEO.

(D) Installed in DFI-2 Packs: The number of DFI-2 packs installed in this office. To calculate:

DFI-2 Packs Per TSS *Column B*	□	Installed DLTU2s Per TSS *Column C*	=	Installed DFI-2 Positions *Column D*

(E) Working DS1 per TSS: The total working DS1s per TSS. Obtain information from switch or TEO.

(F) Available Spare DFI-2 Positions: The DFI-2 positions not being used today. To calculate this number:

Installed DFI-2 Packs *Column D*	-	Working DS1s Per TSS *Column E*	=	Available Spare DFI-2 Positions *Column F*

(G) Forecasted DS1 Inputs EOP: The total number of DS1 inputs forecasted to EOP, including RSM umbilicals. Enter only field for total.

(H) Percent Utilization of DFI-2 - Today: The percent of the DFI-2 positions installed that are being used today. Enter only in field for total.

Total Working DS1s Packs Installed Column E Total _____ Total Installed DFI-2 packs *Column D*	□ 100 =	Percent Utilization of DFI-2 - Today *Column H*

(I) Percent Utilization of DFI-2 - EOP: The percent of the DFI-2 packs installed that will be used at the end of this engineering period. Enter only in field for total.

Forecasted DS1 Inputs EOP *Column G* _____ Total Installed DFI-2 *Column D*	□ 100 =	Percent Utilization of DFI-2 - EOP *Column I*

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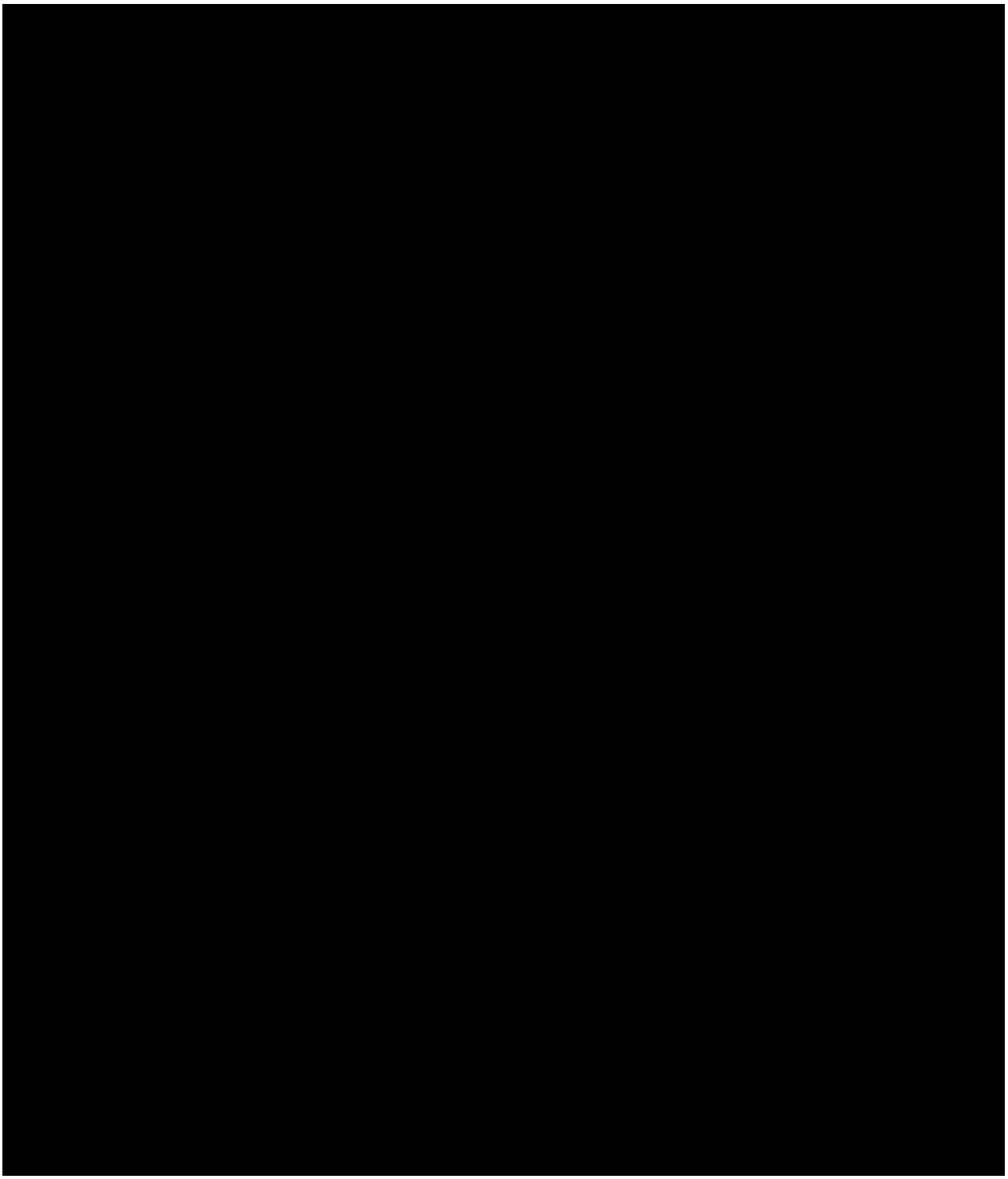

Figure 10.11-1 DLTU2 RSM Assignment

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Figure 10.11-2 DLTU Terminations Worksheet

Figure 10.11-3 DLTU2 Terminations Worksheet

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10.12 GLOBAL DIGITAL SERVICES

10.12.1 GENERAL

Global digital services consist of equipment physically contained in one or more switching modules (either SM or SM-2000) that is accessed by other SMs/SM-2000s within the switch. This equipment includes 3- and 6-port conference circuits and transmission test facilities (TTFs).

The functions once provided by the GDSU are provided by a single circuit pack called the global digital service function (GDSF) circuit pack. This section provides descriptions of both the GDSU and the GDSF.

10.12.2 GLOBAL DIGITAL SERVICE UNIT

10.12.2.1 UNIVERSAL CONFERENCE CIRCUITS

The universal conference circuits (UCCs) are equipped in the global digital service unit (GDSU) and are located in one or more switching modules (SMs). The types of UCCs consist of 3-port and 6-port conference circuits. The maximum number of GDSUs per office is limited to 32 through software release 5E5. In software release 5E6, the switch supports 64 GDSUs, and in software release 5E7, 128.

The UCCs are provided on a per-office basis. A maximum of 8 GDSUs, which contain UCCs may be installed in the SM. For non-OSPS offices, the 3-port conference circuits are used for 3-way calling (multiway features), local test desk access, attendant console, multi-button key sets, central attendant service, line time slot bridging, and E911. For OSPS offices, the 3-port conference circuits are used for operator verification and service evaluation functions. The UCCs are engineered for a blockage of 0.1 percent ABS.

Six-port conference circuits are used specifically for 6-way station-controlled conference and attendant conference and are engineered based on traffic usage. The CCS usage for the 6-port circuits may be estimated based on the expected penetration of the conference calling features of business and residence custom services (BRCS). The 6-port circuits are not used to replace 3-port circuits or to perform the same type of functions. The data related to 6-port and 3-port conference circuits are also shown in Section 10 of the TRFC30 report.

10.12.2.2 ENGINEERING CONSIDERATIONS

The GDSU contains the UCCs that perform functions for all lines and/or trunks in the system. The transmission test facility (TTF) circuit packs are also equipped on the GDSU. The number of TTF circuits equipped in the GDSU determines the quantity of UCCs which can be equipped in each of the two service groups. Each GDSU service group has space for up to seven circuits.

The calculation of 3-port conference circuit requirements is identical to that of 3-port conference circuits in other systems with the exception that 3-way calling, service observing, and operator verification are the only *5ESS*® switch features requiring them. The engineering criteria are a probability of blocking of 0.05 at 85 percent occupancy OAM (P.001 ABS). At least one conference circuit is required. In small to moderate offices, only one GDSU may be required.

The UCCs, each containing two or five 3-port conference circuits or two 6-port conference circuits, utilize time slots remaining after allocation to the TTF and measurement (responder) packs. If required, additional GDSUs are provided, each having a capacity of ten 3-port conference circuits (or five 6-port conference circuits). Each unit is allocated 64 module time slots [two peripheral interface data buses (PIDBs)].

The GDSU contains 2 service groups of 32 time slots each. These service groups may be engineered in several ways depending on the needs, but the total of 32 time slots must not be exceeded per group. There are five different circuit packs available. To maximize the utilization of time slots, several combinations are available. These circuit packs and the associated time-slot requirements are provided in Table 10.12-1 .

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Table 10.12-1 GDSU Capacities

CIRCUIT PACK TYPE	TITLE	TIME SLOTS USED
TTF	Transmission Test Facility	10
R **a**	Responder	4
U **b**	3-port, 2 circuits/pack	6
6	6-port, 2 circuits/pack	12
U2 **b**	3-port, 5 circuits/pack	15

Notes:

a. Required if TTF is equipped.

b. U and U2 circuit packs cannot be mixed within the same service group.

Each 6-port is assigned six time slots. One 6-port conference circuit cannot be used as two 3-port circuits. Like the 3-port conference circuits, the 6-port conference circuits are engineered based on usage. The 6-port conference circuits can be mixed with the 3-port conference circuits. The CCS usage of the 6-port conference circuit may be estimated based on the penetration of the multiway calling feature of BRCS.

10.12.2.3 ASSIGNMENT GUIDELINES

No assignments are required for UCCs.

10.12.2.4 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Section 10 of the TRFC30 report contains measurements concerning the UCCs. Measurements are provided for 3-port and 6-port conference circuits.

The conference circuit overflow (CCOFL) count represents the number of times that requests for a 3- or 6-port conference circuits cannot be served due to unavailability. This situation has no effect on plain old telephone service (POTS) calls but it does affect such features as 3-way calling, conference calling, etc. The CCOFL measurement is considered to be a key service indicator.

For further description of the UCC measurements, refer to 235-600-750 *Output Messages Manual.*

10.12.2.5 FEATURE IMPACT

The penetration of 3-way Calling and Multiway Calling features have a great impact on the usage of 3- and 6-port circuits. Other features which have an impact on these UCCs include multiway features, attendant features, centralized attendant services, line time slot bridging, E911, and release link trunks.

The line time slot bridging (LTSB) feature uses the 3-port conference circuits. When the office is engineered via 5 DOPSMOD, the traffic engineer must enter a value for the number of LTSB lines that are to be assigned.

When a line is assigned the LTSB feature, 3-port conference circuits are used only when both locations or the directory numbers are active on the call. So, when one location or directory number is active on a call, the 3-port conference circuit is not used.

The impact that the LTSB feature has on the 3-port circuits varies per application as follows:

- ***Permanent Lines*** This application could be a residence and a business, each with a different directory number, using the same line. The 3-port conference circuit is used each time both directory numbers use the telephone. This application has the potential to be the greatest user of 3-port conference circuits.

- ***Temporary Lines*** This application could be a line working at two locations; for example, a customer moving but keeping the same directory number. This application uses the 3-port conference circuits, but will have little impact. The service is temporary and usually the customer is at one or the

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other location. The only time that the 3-port conference circuit is used is when both locations are active on a call.

- ***Cable Transfers*** – This application could be used for reallocation of cables and pairs. Since only one location would be used there would be no impact on the 3-port conference circuits.

For further information concerning the Line Time Slot Bridging feature, refer to 235-190-103 *Business and Residence Features*.

10.12.2.6 TRANSITION IMPACT

Growth procedures have no particular impact on UCCs except in cases where additional customers are added, and those customers are allowed to use the features which employ UCCs. In that case, it is necessary to consider the available UCC capacity before allowing the new customers to use those features.

For further information relating to growth, refer to the following documents:

- 235-118-XXX - *Recent Change Procedures*
- 235-105-231 - *Hardware Change Procedures*
- 235-600-30X - *Equipment Configuration Data*.

10.12.2.7 GLOBAL DIGITAL SERVICE UNIT WORKSHEET

The following paragraphs identify the columns of the GDSU worksheet (Figure 10.12-1) and describe the calculations required to complete the worksheet.

(A) Circuit Type: The type of circuit, which will be either 3-port or 6-port conference circuits.

(B) Engineering Blocking Criteria: The engineering blocking criteria used to engineer this component. Valid entries include the following percent blocking values: 0.05, 0.1, 0.5, 1.0, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

(C) Circuits Installed - Total: The quantity of conference circuits installed in the office, including circuits required for service observing and operator verification. Obtain from switch or telephone equipment order (TEO).

(D) Circuits Installed - SO/OV: This column applies only to 3-port conference circuits. One circuit is provided for each service observing trunk installed in the office, plus one circuit is provided for operator verification. Enter the total number of such circuits in this column. Obtain data from the switch or TEO.

(E) Circuits Installed - Traffic: The quantity of conference circuits provided to meet traffic demand.

Circuits Installed Total *Column C*	-	Circuits Installed SO/OV *Column D*	=	Circuits Installed Traffic *Column E*

(F) CCS Capacity Installed - Total: The CCS capacity of the total number of components installed in the office (*Column C*). Read capacity from appropriate Poisson Table as indicated in *Column B*.

(G) CCS Capacity Installed - Traffic: The CCS capacity of the circuits provided to meet traffic demand (*Column E*). Read capacity from appropriate Poisson Table as indicated in *Column B*.

(H) CCS Usage Data Today - Main Station Demand: The number of 3-port or 6-port main stations working in the switch today. Since 3-port and 6-port conference circuits are also used by RSMs, this

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number must include 3-port or 6-port main stations. Obtain number from office records.

(I) CCS Usage Data Today - CCS Demand: Today's CCS demand on the 3-port or 6-port conference circuits. Use value from the current office engineering data. The office engineering data includes the usage generated by the service observing and operator verification trunks. These trunks are not used in calculating the CCS capacity because of the minimal amount of CCS usage generated.

(J) CCS Usage Data Today - CCS per Main Station: The 3-port or 6-port conference circuits CCS usage per main station at which the office is running today. To calculate:

CCS Usage Data - Today CCS Demand *Column I* / CCS Usage Data - Today MS Demand *Column H*	=	CCS Usage Data - Today CCS/MS *Column J*

(K) CCS Usage Data EOP - Main Station Demand: The number of forecasted 3-port or 6-port main stations to be working in the switch at EOP, or the highest demand in the engineering period. Take the number from the forecast.

(L) CCS Usage Data EOP - CCS per Main Station: Number represents the 3-port or 6-port conference circuits CCS usage per main station at which the office is forecasted to be running at EOP. Since main station and CCS per main station may grow at different rates, projections of future demand for each must be made separately. Obtain data from office forecasts.

(M) CCS Usage Data EOP - CCS Demand: The CCS demand on the 3-port or 6-port conference circuit at EOP. To calculate:

CCS Usage Data - EOP MS Demand *Column K*	□	CCS Usage Data - EOP CCS/MS *Column L*	=	CCS Usage Data - EOP CCS Demand *Column M*

(N) Main Station Capacity - Today: The main station capacity that the 3-port or 6-port conference circuits are capable of handling today, based on the current CCS per main station. To calculate:

CCS Capacity Installed - Traffic *Column G* / CCS Usage Data - Today CCS/MS *Column J*	=	MS Capacity - Today *Column N*

(O) ***Main Station Capacity - EOP:*** The main station capacity that the 3-port or 6-port conference circuits are capable of handling at EOP, based on the forecasted main stations and CCS per main station. To calculate:

CCS Capacity Installed - Traffic *Column G* / CCS Usage Data - EOP *Column L*	=	MS Capacity - EOP *Column O*

(P) ***CCS Usage Percent Utilization - Today:*** The maximum CCS load that is being used today. To calculate:

CCS Usage Data - Today CCS Demand *Column I* / CCS Capacity Installed Traffic *Column G*	□ 100 =	CCS Usage Percent Utilization - Today *Column P*

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(Q) ***CCS Usage Percent Usage - EOP:*** The maximum CCS load that will be used during the period. To calculate:

$$\frac{\text{CCS Usage Data - EOP CCS Demand (Column M)}}{\text{CCS Capacity Installed (Column G)}} \times 100 = \text{CCS Usage Percent Utilization - EOP (Column Q)}$$

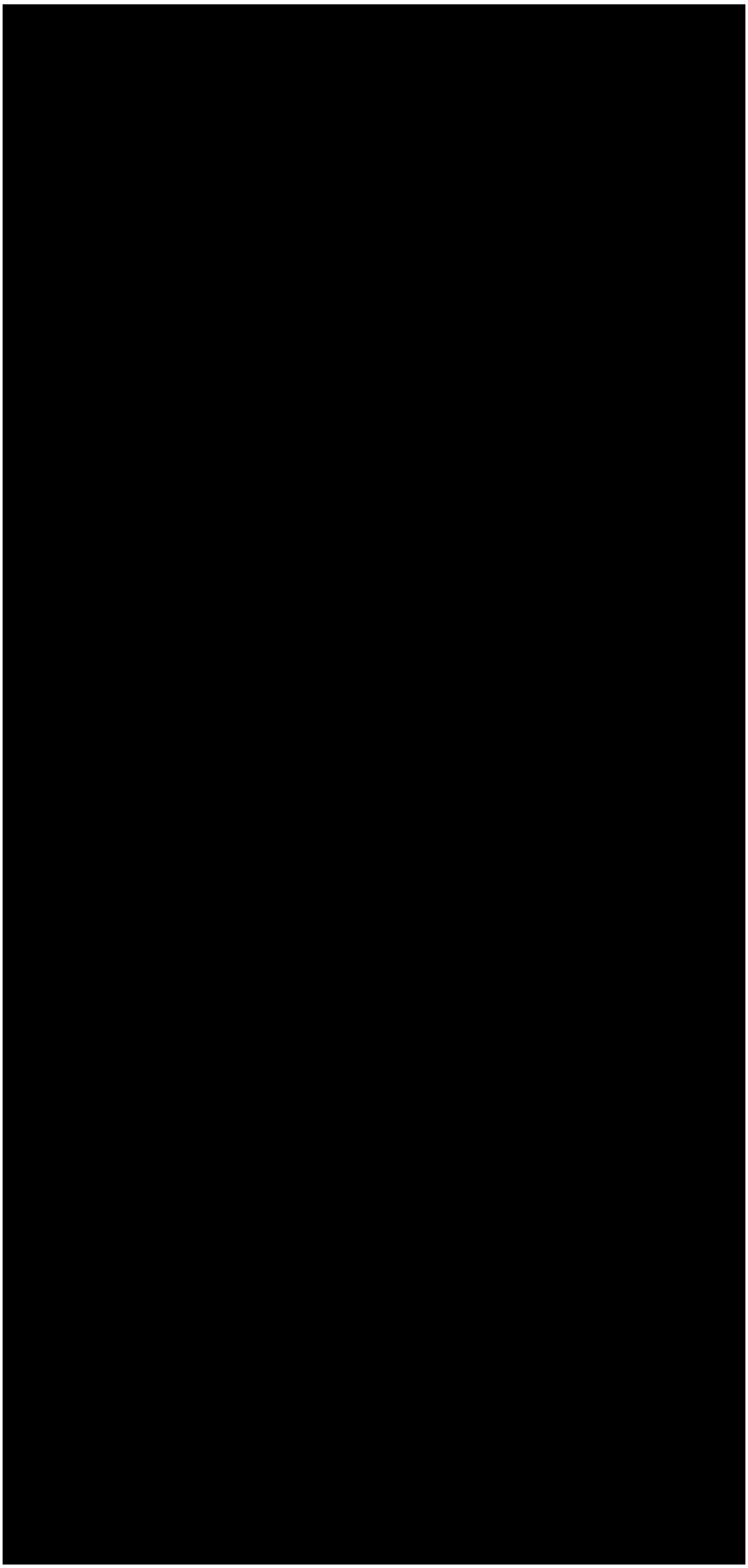

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Figure 10.12-1 Global Digital Service Unit Worksheet

10.12.3 GLOBAL DIGITAL SERVICE FUNCTION

The GDSF combines functionalities that were provided by separate circuit packs such as Transmission Test Facility (TTF), Integrated Services Test Facility (ISTF), 3 Port Conference Circuit (3PORT_CONF) and 6 Port Conference Circuit (6PORT_CONF) in GDSU and DSU2. With GDSF, a DSC3 (UN363) can provide all of these functionalities from a single circuit pack. GDSF can coexist with GDSU and/or DSU2 in the same office.

The intended purpose of the GDSF software is to replace the circuit packs associated with TTF, ISTF, 3PORT_CONF and 6PORT_CONF and to consolidate hardware by utilizing newer technology. DSU2 is still used, in addition to DSC3, whenever there is a need to provide announcement.

Because many functionalities can be provisioned in a DSC3 (UN363), it is important that they be adequately engineered and various functionalities spread over several DSC3 (UN363) packs. For reliability, at least two DSC3 (UN363) packs are equipped in the SM-2000. In smaller offices with only one SM, a spare DSC3 (UN363) pack should be available for quick replacement.

A summary of Local and Global Digital Services Functions is shown in Table 10.12-2 .

Table 10.12-2 Summary of Global Digital Services Functions (GDSF)

FUNCTION	UNIT	PACK	PIDB	MAX. PACKS
SM BEFORE GDSF SOFTWARE				
3/6 port conf. TTF ISTF	GDSU GDSU DSU2	UCC TTF ISTF	2 per GDSU 2 per GDSU 1 /pack	Engineerable Engineerable Engineerable
SM AFTER GDSF SOFTWARE				
3/6 port conf., TTF & ISTF	DSU2	DSC3	1 or 2/ pack	1
SM-2000				
3/6 port conf., TTF, ISTF	DSU3 or SMPU5	DSC3	4 /pack	36

Only Universal Conference Circuit (3/6 port) functionality of GDSF is available starting with the 5E10 software release. TTF and ISTF functionality will be available, approximately three months later, by a software update, for both the SM and the SM-2000.

10.12.3.1 GLOBAL SERVICES

The circuit pack DSC3 (UN363) and associated Local Digital Services Function (LDSF) software provides increased capacity for local digital services to meet increased demand of SM-2000. These local functions are: Local Tone Generator, Digit Receptor and Transceiver and Voice Band Services. In the 5E10 software release and in the subsequent software update, additional GDSF software is introduced to provide global digital services functions for both SM and SM-2000 on the same DSC3 (UN363) circuit pack. The functionalities provided by the GDSF are:

- 3 Port Conference Circuit
- 6 Port Conference Circuit
- Transmission Test Facility (TTF)
- Integrated Services Test Facility (ISTF).

10.12.3.2 Engineering

10.12.3.2.1 Recent Change

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The GDSF can be readily provisioned via Recent Change (RC) to perform TTF, ISTF and Conference Circuit (CC) functions interchangeably. Since there are no specific circuit packs required for specific functions, a simple provisioning change can provide needed functionality.

10.12.3.2.1.1 Predefined Configuration

The assignment of the functionality is done via RC/V. The GDSF has eight types of predefined configurations, a subset of which is used for the U. S. market. The SM-2000 uses four PIDBs, but the SM can be configured with one or two PIDBs. The maximum capacity of the GDSF is 32 UN363 packs per SM-2000 and one UN363 pack per SM. See Tables 10.12-3 and 10.12-4 .

Table 10.12-3 Predefined GDSF Circuit Configurations - SM-2000

CONFIG	CC (a)	TTF		ISTF		EQUIPMENT	COMMENT
TYPE NO	TS	BASE	+2	XMT	XLB	CKT (b)	
GDSF-SM 2000 CONFIGURATION							
1	128	0	0	0	0	0	Conf. only
2 c	30	0	2	0	0	0	Conf. & TTF
4	60	0	0	10	44	3	Conf. & ISTF
5	30	2	0	4	32	1	Conf., TTF & ISTF
7	0	0	0	16	32	4/5	ISTF only
8	60	0	2	0	0	0	Conf., TTF

Notes:

a. Time slots available for combinations of 3 or 6 port conference circuits. Only 126 time slots used out of 128 available time slot.

b. Equivalent ISTF conventional circuit packs.

c. Provides more 105 tests.

Table 10.12-4 Predefined - GDSF Circuit Configurations - SM

CONFIG	CC	TTF		ISTF		EQUIPMENT	COMMENT
TYPE NO.	TS	BASE	+2	XMIT	XLB	CKT. (a)	
GDSF-SM CONFIGURATION - ONE PIDB							
1	32	0	0	0	0	0	Conf. only
2 b	0	0	2	0	0	0	TTF
4	0	0	0	4	28	1	ISTF only
5	0	2	0	4	8	1	TTF & ISTF
6	24	0	0	6	2	2	Conf. & ISTF
7	24	1	0	0	0	0	Conf. & TTF
8	12	0	1	4	4	1	Conf., TTF & ISTF
GDSF-SM CONFIGURATION - TWO PIDBs							
1	64	0	0	0	0	0	Conf. only
2 b	30	0	2	0	0	0	TTF
4	0	0	0	8	56	2/3	ISTF only
5	0	4	0	4	28	1	TTF & ISTF
6	30	0	0	12	22	4	Conf. & ISTF
7	48	2	0	0	0	0	Conf. & TTF
8	30	0	1	4	16	1	Conf., TTF & ISTF

Notes:

a. Equivalent ISTF conventional circuit packs.

b. Provides more 105 tests.

10.12.3.2.2 GDSF in the SM

In the SM, the DSC3 (UN363) is mounted in the Combined Services Unit and not in DSU3. The DSC3 (UN363) can be only used to provide global functions in the SM, it cannot be used to provide local functions.

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10.12.3.2.2.1 Engineering Rules

10.12.3.2.2.1.1 GDSF-SM

The following are the engineering rules for the GDSF-SM:

- One GDSF-SM DSC3 is expected to be required with typical Administrative Workstation Configuration (VCDX) SM configurations while additional GDSF-SM DSC3s may be required with "non-VCDX" SM configurations.
- The GDSF-SM DSC3 is equipped in the CSU. A CSU can only support a single GDSF-SM DSC3.
- Only one GDSF-SM DSC3 is allowed per SM.
- Only ISTF functionality with the GDSF-SM is supported with RSM's. Conferencing and TTF testing are not supported with the GDSF. Therefore, with RSM's only the GDSF-SM circuit configuration which provides all ISTF testing (configuration type 4) is supported with RSMs. RSMs are currently not supported using SM-2000. Therefore, GDSF-SM- 2000's/DSU3's are not supported with RSMs. Only the GDSF-SM/CSU can be used to be provide ISTF testing (only) in RSMs.
- The GDSF-SM DSC3 is a global resource, and is not required in every SM (since it can be accessed by any other SM/SM-2000 in the office).
- Each GDSF-SM DSC3 must be equipped with one or two PIDB and one PICB, all of which are duplexed. The first PIDB (PIDB 0) must always be equipped on the DSC3. Equipage of 3, or 4 PIDBs is not supported with the GDSF-SM DSC3. The supported GDSF-SM circuit configuration types are shown in Table 10.12-5 .
- Assignments of CCs for 3/6 port conference circuits can be mixed.
- Up to ten 3-port conference circuits can be assigned on a GDSF-SM DSC3 using 30 channels.
- Up to five 6-port conference circuits can be assigned on GDSF-SM DSC3 using 30 channels.
- For applications requiring TTF service functions to support trunk testing, DSC3 DSP resources may be shared (for example, configuration types 2, 5, 7, and 8) assuming both types of tests do not need to be run concurrently. Concurrent test requirements by the customer would require additional DSP resources and additional GDSF-SM DSC3s (based on circuit configurations in Table 10.12-5).
- The number of GDSF-SM DSC3s needed to support conferencing and testing can be calculated using information in Table 10.12-5 .
- The GDSF-SM DSC3 can coexist with GDSU and DSU2 hardware per office, on an SM basis.

10.12.3.2.2.1.2 GDSF-SM-2000

The following are the engineering rules for the GDSF-SM-2000:

- The DSC3 pack is a global resource, and is not required in every SM-2000 (since it can be accessed by any other SM-2000/SM in the office).
- Full functionality of GDSF is not supported in Remote SM (RSM, ORM or EXM). The ISTF functionality can be provided in the Remote SM.
- Up to 32 GDSF-SM-2000 DSC3 packs can be supported in an SM-2000. (This is the software limit. It would be highly unlikely to approach this limit since the GDSF-SM-2000 is a global resource.)

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- GDSF-SM-2000 DSC3 packs are equipped in the DSU3. DSC3 pack slots in the DSU3 are shared with DSC3s providing LDSF in the SM-2000. A DSU3 consists of six fuse groups with up to three DSC3s per fuse group.
- Each GDSF-SM-2000 DSC3 pack requires four PIDBs and one PICB, all of which are duplexed.
- The supported GDSF-SM-2000 circuit configuration types are covered in Table 10.12-5 . The configuration types provide the supported mix of 3/6 port conferencing, and testing with TTF and ISTF.
- Up to 42 3-port conference circuits can be assigned on a GDSF-SM-2000 DSC3.
- Up to 21 6-port conference circuits can be assigned on a GDSF-SM-2000 DSC3.
- For applications requiring TTF service function to support trunk testing, DSC3 DSP resources may be shared (for example, configuration types 2, 5, and 8) assuming both types of tests do not need to be run concurrently. Concurrent test requirements by the customer would require additional DSP resources and provisioning of additional GDSF-SM-2000 DSC3s
- The number of GDSF-SM-2000 DSC3s needed to support conferencing and testing can be calculated.
- The GDSF-SM-2000 DSC3 can coexist with GDSU and DSU2 hardware per office, on an SM-2000 basis.

Table 10.12-5 SM-2000 and SM GDSF Capacities

	MAXIMUM CAPACITY PER		
CIRCUIT TYPE	**UN363**	**SM-2000**	**([a])**
3-port Conference Circuits	42	1344	1800
6-port Conference Circuits	21	672	250
Tone Generator (TNGEN) Circuits	48	1536	**b**
Tone Transceiver (TNXCVR) Circuits	16	512	**b**
Guard-Data-Guard (GDTNXCVR) Circuits	6	192	**b**
ISTF XMIT (ISTFXMIT) Circuit	16	512	**b**
SM GDSF CAPACITIES - ONE PIDB			
3-port Conference Circuits	10	10	1800
6-port Conference Circuits	5	5	250
Tone Generator (TNGEN) Circuits	24	24	**b**
Tone Transceiver (TNXCVR) Circuits	12	12	**b**
Guard-Data-Guard (GDTNXCVR) Circuits	4	4	**b**
ISTF XMIT (ISTFXMIT) Circuits	6	6	**b**
ISTF Loop Back (ISTFLB)	28	28	**b**
SM GDSF CAPACITIES - TWO PIDBs			
3-port Conference Circuits	20	20	1800
6-port Conference Circuits	10	10	250
Tone Generator (TNGEN) Circuits	24	24	**b**
Tone Transceiver (TNXCVR)Circuits	12	12	**b**
Guard-Data-Guard (GDTNXCVR) Circuits	4	4	**b**
ISTF XMIT (ISTFXMIT) Circuits	6	6	**b**

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ISTF Loop Back (ISTFLB)	28	28	**b**

Notes:

a. Software limit.

b. In the table, office maximum means that no specific maximum exists, but the number of logical test ports available and trunk group/member maximums will limit the number of these circuit types that can be equipped in an office.

10.12.3.2.3 Recommendations

10.12.3.2.3.1 GDSF-SM

- For VCDX SM configurations, one GDSF-SM DSC3 is recommended. As previously noted, the CSU supports one GDSF-SM DSC3.
- For "non-VCDX" SM configurations (hosts), a minimum of two GDSF-SM DSC3s is recommended per office for reliability. Since only one GDSF-SM DSC3 is supported per SM, additional GDSF-SMs/CSUs need to be distributed across different SMs.
- Since conferencing and testing are typically required in most offices, it is recommended that configuration type 8 (which provides a mix of all supported functions) be initially provisioned. Type 7 could also be provisioned if ISTF is not required (for example, offices without C7 or ISDN). For "non-VCDX" SM configurations, additional GDSFs may be required based on the requirements of a particular application.

10.12.3.2.4 GDSF-SM-2000

- A minimum of two GDSF-SM-2000 DSC3s is recommended per office for reliability. [Note - only one GDSF- SM-2000 DSC3 may be provided with specific SM-2000 configurations (for example, VCDX-SM-2000)]
- Since conferencing, and (analog/digital) testing are typically required in most offices, it is recommended that configuration type 5 (which provides a mix of all supported functions) be initially provisioned as the minimum two GDSF-SM- 2000 DSC3s. Type 2 or 8 could also be provisioned if ISTF is not required (without C7 or ISDN). Additional GDSFs may be required based on the requirements of the particular application.
- GDSF-SM-2000 DSC3 packs should be distributed among different SM-2000s, if possible for reliability reasons.
- For VCDX-SM-2000, CM2C configurations, or offices with only a single SM-2000/DSU3, it is recommended that the two GDSF-SM-2000 DSC3s be distributed across separate fuse groups in the DSU3.

10.12.3.3 Hardware

10.12.3.3.1 Digital Services Circuit Model 3 (DSC3) in SM-2000

Digital Services Circuit Model 3 is used in SM-2000 to provide local digital services function. The capability of this circuit is expanded by downloading of global digital services function software in the circuit pack. The DSC3 (UN363) are mounted in the DSU3 unit and must be provisioned according to the predefined configurations.

10.12.3.3.2 Numbering of GDSF SM-2000

The GDSF has its own numbering universe of 32 Service Groups. An SM-2000 can have a maximum of 32

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DSC3s (UN363s). The DSC3 (UN363) provisioned as LDSF must be mounted in base DSU3 shelf in the SM Controller (SMC) cabinet. Any DSC3s (UN363) provisioned as GDSFs over and above the 18 slots available in the base DSU3 must be mounted in the LTP cabinet.

10.12.3.3.3 GDSF In The SM

In the SM, the DSC3s (UN363s) are mounted in the Combined Services Unit (CSU). Only one UN363 can be mounted in a CSU and is always numbered 0 (zero).

10.12.3.4 Software

10.12.3.4.1 GDSF Circuit Configurations

GDSF circuit configurations for GDSF-SM-2000 and GDSF-SM are provided in Tables 10.12-3 and 10.12-4 . (The current GDSF circuit configurations are preliminary and subject to change at a later date.) The GDSF (like the LDSF and ISTF) is a pumpable peripheral. Therefore, the Digital Signal Processor (DSP) configuration information needs to be provided (and coordinated) as input parameters to the ODA engineer, to insure the correct GDSF service types are provisioned on a DSC3 basis. (for example, the mapping of the specific configuration type for each GDSF engineered).

The number of conference channels (CC) supporting 3/6 port conferencing are provided in Table 10.12-5 .

For testing, the mapping of the existing TTF and ISTF services to equivalent GDSF service types are highlighted as follows:

- With the TTF, the basic TTF includes one responder. Up to two additional responders can be engineered with the TTF. The equivalent GDSF configurations for TTF are noted as BASE (for the basic) and BASE+2 (with 2 additional responders) in Tables 10.12-3 and 10.12-4 . The mapping of TTF to the GDSF circuit configurations only supports an equivalent BASE+2, with no equivalent for a TTF with only one additional responder. Therefore, a configuration type which includes a BASE+2 TTF needs to be provided for cases requiring a TTF with only one additional responder.

- With ISTF, the two different service types supported are transmit (XMIT) and loopback (XLB).

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10.13 LOCAL DIGITAL SERVICE UNIT

10.13.1 TONE DECODERS

10.13.1.1 Description

The tone decoder (TD) resides in the local digital service unit (LDSU) of the switching module (SM). The TDs perform digit reception and decoding functions for dial pulse and touch-tone originating calls from lines. Additionally, they perform touch-tone multifrequency and dial pulse (except bylink) digit reception from incoming trunk calls. (Incoming bylink digits are received by the signal processor in the SM processor unit.)

Tone decoders are used on a per-call basis and are engineered. This is done by estimating the total touch-tone multifrequency, multifrequency (MF), and originating and nonbylink incoming dial pulse once-a-month (OAM) or average busy season (ABS) and high day (HD) usage, and allocating that usage to each required SM. Per-SM usage is read into Poisson 0.03 blocking probability tables [time-consistent busy hour (TCBH) engineering criteria are blocking probability of 0.01 ABS or 0.05 HD, whichever is limiting], and the resulting circuit requirement is increased by four to accommodate expected decoder usage variation that occurs between modules and is caused by unit loading. (There are 14 circuit positions in the LDSU which are available for TDs. Each TD circuit pack contains two or four TDs depending on the software release and LDSU model employed.)

On each of the two DSU2 boards there are 7 digital signal processors (DSPs). These DSPs may be configured for tone generating, tone decoding, or tone transceivers functions. The default configuration is one DSP per board for tone generation (equivalent to the DSU1). The transceivers are engineered and spread among the DSU2s. The remaining DSPs are the decoders. Each DSP converted to a decoder is equivalent to 5 servers. Usually 5 or 6 DSPs are assigned to the tone decoder function. This is the equivalent of 60 to 50 decoder servers.

10.13.1.2 Engineering Considerations

The TD circuits are provided on a per-SM basis. For 2 TD circuits per pack, an SM can be equipped with up to 28 TD circuits to provide an OAM capacity of 681 hundred call seconds (CCS). For 4 TD circuits per pack, an SM can be equipped with up to 56 TD circuits for a corresponding OAM capacity of 1,540 CCS. Normally, fewer than 28 circuits per SM are engineered based on the projected load. Because the ratio of lines to trunks varies somewhat among SMs, the volume of usage varies among tone decoder groups. (A higher ratio of lines generally means higher tone decoder usage.) This variance is accounted for in the engineering procedures by determining the average tone decoder group size needed, then adding a safety margin to all groups to cover the highest expected SM load.

Tone decoder data is provided by Section 9 of the TRFC30 report. The tone decoders should be monitored for any groups that approach or exceed capacity.

When the tone decoders exceed capacity, originating calls suffer. Originating customers cannot be provided dial tone if a tone decoder is not available. Corrective actions may include the addition of more tone decoders, or moving tone decoders from one SM to another.

10.13.1.3 Assignment Guidelines

Tone decoder circuits are installed on a per-SM basis. The only assignments required are those assignments which indicate to the software release that the additional TDs are available.

10.13.1.4 Measurements and Primary Service Indicators

10.13.1.4.1 General

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Tone decoder measurements are found in Section 9 of the 30-minute traffic report. Additionally, Section 4 of the TRFC30 report contains TD and dial tone speed measurements related to system access delay. The 235-600-750, *Output Messages Manual* provides additional information concerning these measurements.

10.13.1.4.2 Tone Decoder Attachment Delay

Tone decoders are used to perform dial pulse and touch-tone digit collection from lines. Additionally, they perform MF and dial pulse (except bylink) digit collection from trunks. For nonbylink trunks, the tone decoder attachment delay (TDAD) measurement is the equivalent of dial tone delay for lines.

The TDAD is a count of the number of times, during the measuring interval, that TDAD exceeded 3 seconds.

NOTE: SS7 trunks use the tone transceivers. The TDAD measurements do not apply.

10.13.1.4.3 Dial Tone Delay

In the *5ESS*® switch, the dial tone delay peg count (DTDPC) is an indication of the ability of the machine to provide dial tone to customers within 3 seconds during the measuring interval. It is the primary measurement for evaluating the capability of providing originating customer service. Each call in the *5ESS*® switch is sampled for dial tone delay, and the number of calls sampled is recorded by the dial tone delay sample count (DTDSC). However, the DTDPC count is incremented only when an originating customer experiences dial tone delay of more than 3 seconds. Both DTDSC and DTDPC are available for each SM. These measurements are obtained from Section 4 of the TRFC30 report.

It should be noted that receipt of dial tone indicates only the readiness of the SM. It is possible, though highly improbable, that the administrative module or communication module (AM/CMP) could have problems which may cause the customer to experience post dial tone processing delay. Section 4 of the TRFC30 report provides measurements related to system delay (specifically blockage due to overload).

Typically, the most common reason for excessive dial tone delay is blocking in the LU. Blocking in the HLSC or UTD is also possible, but this is not as likely as LU blockage. Another remote possibility for excessive dial tone delay is high switching module processor (SMP) occupancy. If the dial tone delay peg count is excessive and if the tone decoder attachment delay is zero, then the SMP can be eliminated as the source of the trouble.

10.13.1.4.4 Tone Decoder Total Usage and Overflow

The tone decoder total usage (TOTUSG) count provides the usage for tone decoder groups. This count represents the sum of the traffic and maintenance usage for the group. Tone decoder usage varies according to the line-to-trunk ratio on the SM.

Tone decoders should be monitored for any groups that approach or exceed capacity (1442 CCS per 56 decoders at 1.0 percent blocking). When the tone decoders exceed capacity, originating calls suffer. Originating customers cannot be provided dial tone if a tone decoder is not available. Corrective actions may include the addition of more tone decoders, or moving tone decoders from one SM to another.

10.13.1.5 Feature Impact

The use of features or implementation of new features has no effect on TDs except in the event that the features cause an increase in call volumes.

10.13.1.6 Transition Impact

Tone decoder circuits are installed on a per SM basis. Data base changes are required to indicate the availability of the additional TDs to the software release. Information related to growth of TDs can be found in the following documents:

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- 235-118-XXX - *Recent Change Procedures*
- 235-105-231 - *Hardware Change Procedures*
- 235-600-30X - *Equipment Configuration Data*.

10.13.2 REVERTIVE PULSE TRANSCEIVERS

10.13.2.1 Description

The revertive pulse (RP) transceivers may be employed in the *5ESS*® switch LDSU to provide RP signaling. This method of signaling originated with panel offices and is present in No. 1 Crossbar and the 1/1A *ESS*™ switch. This allows the *5ESS*® switch to process originations from, and terminations to offices which use RP signaling.

Three types of interoffice RP connections are supported in the *5ESS*® switch. These are:

- End office to end office
- End office to tandem office
- Tandem office to end office.

Each trunk carries the same number of selections. The RP trunks are maintained in RP trunk groups, and the trunks are 1-way only. Further, all RP trunks are digital trunks; analog RP trunks are not supported. If necessary, D4 channel banks may be used to convert analog trunks to digital trunks.

When an RP call is detected, the RP trunk is connected to the selected RP transceiver through the time slot interchanger (TSI). The RP transceiver has a dedicated time slot to provide the required signaling function. The RPs are generated at the terminating end of the trunk, and the transmitting office counts the pulses and transmits the start and stop signals to the terminating office.

The signaling interface between the RP trunks and the RP transceivers consists of the "A" and "B" signaling bits of the T1 digital trunks. The RP transceiver is capable of transmitting and receiving the RP selections via the "A" and "B" signaling bits. It also performs the various handshake protocols and timing required for RP signaling.

10.13.2.2 Engineering Considerations

Each LDSU service group may have one RP transceiver circuit board. Each board contains 32 RP transceiver circuits; however, all of these circuits need not be equipped in the SM. When fully equipped, the service group can handle 32 concurrent RP calls. This may be any combination of originating or terminating calls.

The real time required by an RP call is approximately the same as other trunk calls, in both the AM and the SM.

10.13.2.3 Assignment Guidelines

The RP transceivers are installed in the LDSU. Assignments are not required other than the recent change procedures required to indicate the availability of these circuits. Each RP trunk must have the appropriate assignments made through the recent change procedures. Refer to 235-118-XXX - *Recent Change Procedures* for these assignments.

10.13.2.4 Measurements and Key Service Indicators

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Section 25 of the TRFC30 report contains measurements associated with the RP transceivers. These measurements include peg count, usage, overflow, and maintenance usage. These measurements are taken for each SM. 235-600-750, *Output Messages Manual* provides additional information concerning these measurements.

10.13.2.5 Feature Impact

The use or implementation of features has no impact on RP transceivers.

10.13.2.6 Transition Impact

The RP transceivers are not affected by growth procedures other than the growth of RP trunks which provide additional load for the transceivers. The measurements should be monitored subsequent to that type of growth to ensure that overflow situations do not occur.

The growth of RP transceivers may be done through the installation of additional RP transceiver circuits (if necessary) and defining them in the data base. This is done through recent change procedures. Refer to the following documents for information related to these growth procedures:

- 235-118-XXX - *Recent Change Procedures*
- 235-105-231 - *Hardware Change Procedures*
- 235-600-30X - *Equipment Configuration Data.*

10.13.3 LOCAL DIGITAL SERVICE UNIT WORKSHEET

The following paragraphs identify the columns of the LDSU worksheet (Figure 10.13-1) and describe the calculations required to complete the worksheet.

(A) Decoders Installed per SM: The number of tone decoders installed per SM. In some offices, the last SM may have a different number of tone decoders than the other SMs in the office. Obtain this number from the switch or the telephone equipment order (TEO).
Decoders per SMs + Decoders in Last SM = Total Decoders *Column A*

(B) Engineered Blocking Criteria: The blocking criteria used to engineer this component. Valid entries include the following percents blocking: 0.05, 0.1, 0.5, 1.0, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

(C) CCS Capacity per SM: The CCS capacity from the appropriate Poisson Table, based on the number of UTDs (universal tone decoders) installed per SM and the percent blocking.

(D) Number of SMs Installed: The number of SMs installed in the office. Obtain this number from the switch or the TEO.

(E) Total Exchange CCS Capacity: The total CCS capacity of the installed UTD for the office. To calculate:

CCS Capacity Per SM *Column C*	□	Number SMs Installed *Column D*	=	Total Office CCS Capacity *Column E*

(F) CCS Usage Data Today - Equivalent Main Station and Trunk Demand: The number of main stations plus the number of equivalent trunks. To calculate, multiply the working trunks by 1.6, then add the working main stations. Each trunk will average 1.6 times the usage of an average main station. (Exclude trunks that are from a step-by-step office, immediate start or bylink.) Obtain these

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numbers from the current office main station and trunking report.
Working MSs + (Working Trunks □ 1.6) = Equivalent MSs

(G) CCS Usage Data Today - CCS Demand: The CCS demand on the UTD circuits today. Read value from the current office engineering data.

(H) CCS Usage Data Today - CCS per Equivalent Main Station: The UTD circuits, CCS usage per equivalent main station at which the office is running today. Obtain figure from the current office engineering data or calculate:

CCS Usage Data - Today CCS Demand *Column G* _____ EMS Demand *Column F*	=	CCS Usage Data - Today CCS per EMS *Column H*

(I) CCS Usage Data - EOP - EMS Demand: The number of main stations plus the number of equivalent trunks for EOP, or the highest demand during the engineering period. (Exclude trunks from a step-by-step office, immediate start or bylink.) Obtain these numbers from the main station forecast and the trunking forecast.
Forecasted MSs + (Forecasted Trunks □ 1.6) = Forecasted Equivalent MSs

(J) CCS Usage Data - EOP - CCS per Equivalent Main Stations: This number represents the tone decoder CCS usage per equivalent main station at which the office is forecasted to be running at the EOP. Since main stations and CCS per main station may grow at different rates, projections of future demand for each must be made separately. The current CCS/EMS may need to be used if no forecast exists.

(K) CCS Usage Data - EOP - CCS Demand: The forecasted CCS demand on the UTD circuits at the EOP. To calculate:

CCS Usage Data - EOP EMS Demand *Column I*	□	CCS Usage Data - EOP CCS/EMS *Column J*	=	CCS Usage Data - EOP CCS Demand *Column K*

(L) Equivalent Main Station and Trunk Capacity - Today: The equivalent main station capacity that the UTD circuits are capable of handling today, based on the current CCS per equivalent main station. To calculate:

Total Office CCS Capacity *Column E* _____ CCS/EMS *Column J*	=	Equivalent Main Station and Trunking Capacity EOP *Column M*

(M) ***CCS Load Percent Utilization - Today:*** The maximum CCS load being used today. To calculate:

CCS Usage - Today CCS Demand *Column G* _____ Total Office CCS Capacity *Column E*	□ 100 =	CCS Load Percent Utilization Today *Column N*

(N) ***CCS Load Percent Utilization - EOP:*** The maximum CCS load that will be used during the period. To calculate:

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CCS Usage Data - EOP CCS Demand *Column K* _____ Total Office CCS Capacity *Column E*	□ 100 =	CCS Load Percent Utilization - EOP *Column O*

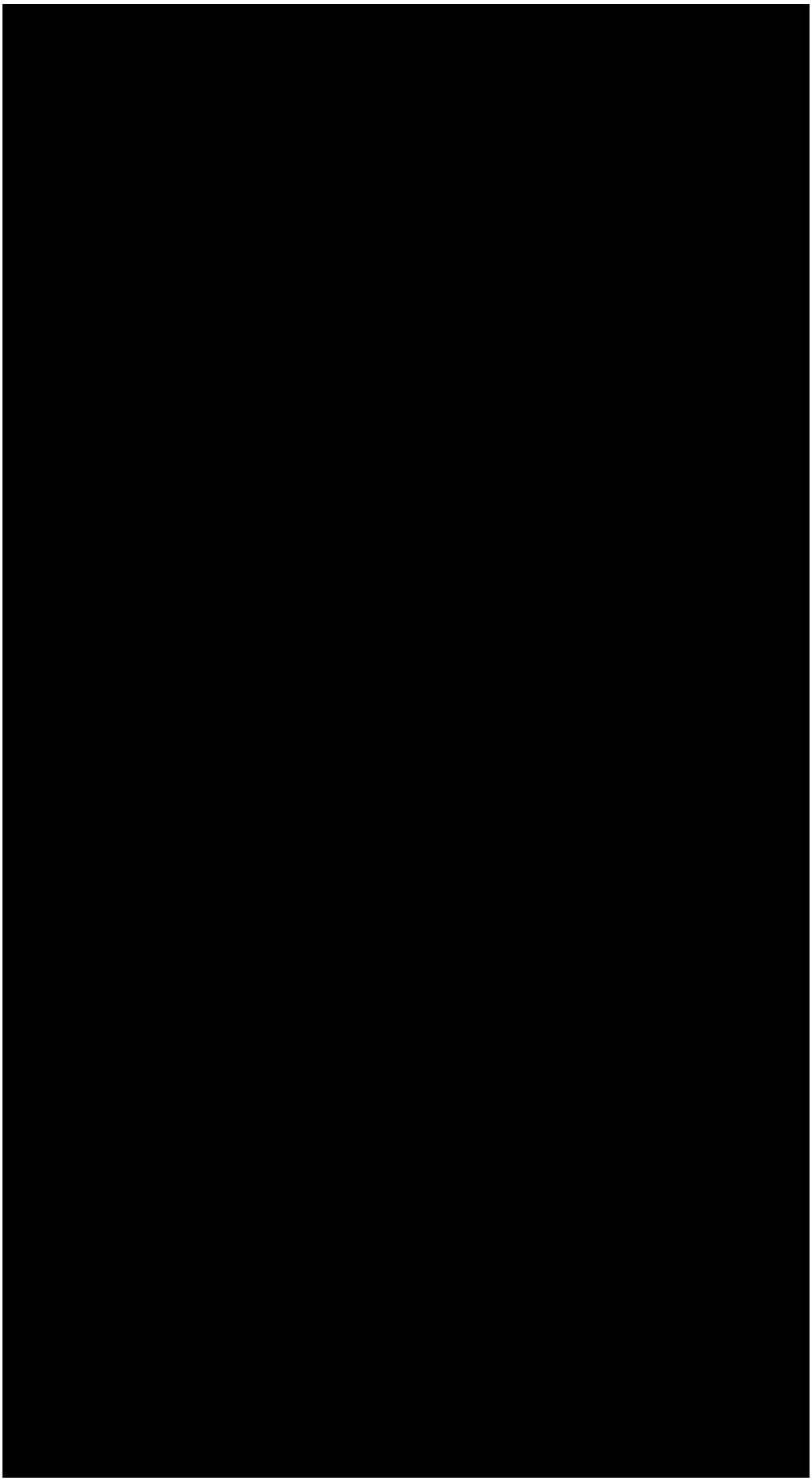

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Figure 10.13-1 Local Digital Service Units Tone Decoders Worksheet

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10.14 DIGITAL SERVICE UNIT □ MODEL 2

10.14.1 DESCRIPTION

Beginning with software release 5E2(2), the digital service unit □ model 2 (DSU-2) was available as an upgraded replacement for the local digital service unit (LDSU). The term LDSU is synonymous with the term digital service unit model 1 (DSU1). The DSU-2 performs tone generation, cadencing, and decoding. In addition to performing the local LDSU functions (tone generation and tone decoding), the DSU-2 performs the following global functions:

- □ Recorded Announcement Function (RAF)
- □ Integrated Service Test Function (ISTF).

In older offices equipped with LDSUs, 5E5 software release local area signaling services (LASS) or common channel interoffice signaling (CCIS) functions can be performed by an LDSU conversion in some of the switching modules (SMs). This conversion will upgrade the LDSU to DSU-2/LDSUF capabilities, which include; voice path assurance (VPA), individual calling line identification (ICLID), and message waiting indicator (MWI). The converted LDSU (now a DSU-2/LDSUF) however, will still not be able to perform the RAF and ISTF functions of the standard DSU-2. The conversion also removes the revertive pulse (RP) functions. With this conversion option, an office could have all three types of digital service units; LDSU, DSU-2/LDSUF, and DSU-2.

The three types can be mixed in the same *5ESS*® switch office. However, they cannot be mixed in the same SM. Since RP is not available in the DSU-2, an SM requiring RP must use an LDSU. The DSU-2 is a versatile unit that uses a digital service circuit (DSC) pack. The DSC board consists of a logical processor (Intel 80186) and seven digital signal processors (DSPs) as shown in Figure 10.14-1 . One DSC pack can replace an entire service group of LDSUs having nine packs (one control pack, one UTG pack, and up to seven UTD packs), with substantial cabinet space savings. This is simply a hardware reduction whereby an entire shelf of 18 circuit packs which provide the 2 service groups of the LDSU can be replaced by 2 DSC circuit packs, 1 for each service group. The DSU-2 is much smaller than the previous LDSU and offers a substantial cost advantage. Additionally, the DSU-2 simplifies the introduction of new services, such as the following:

- □ VPA which is required with common channel signaling (CCS).
- □ Centralized automatic message accounting - transfer decoder (CAMA-TD)
- □ Analog incoming calling line identification (AICLID)
- □ Analog visual message waiting indicator (AVMWI).

Only one DSP is needed for tone generation, and the remainder of DSPs can be provided for TDs. (Each DSP can provide the same functions as 5 TDs used in prior software release programs.) The TDs do not require administration, and the TDs are administered in the same manner as those provided with previous software releases.

10.14.2 Digital Service Unit 2 - Recorded Announcement Function

The DSU-2/RAF can provide independent playback of prerecorded, variable length, and variable content OSPS and BRCS announcements. Each DSU-2/RAF service group provides the following features:

- □ Thirty-two simultaneous, independently phased, announcement channels
- □ A storage architecture where the prerecorded announcements are accessible by all the channels simultaneously

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- The ability to grow the announcement storage capacity to 1250 seconds of speech
- The ability to play back stored variable length and variable content announcements.

For toll and assistance applications, the DSU-2/RAF-dial through announcement (DTA) configuration provides the same features except that only 20 simultaneous, independently phased, announcement channels can be provided.

Announcements provided through the DSU-2/RAF are predetermined for all applications and cannot be changed on site.

A community of DSU-2/RAF announcements is available for BRCS features. This community (DSU-2/RAF-BRCS) is maintained and engineered separately.

The SM configuration for dial through announcement (DTA) includes basic, standard, and loaded configurations, depending upon the application. Software release 5E6 served by the BRCS RAF community added LASS SLE. In addition, a community was added for the ASP feature. All features provide the capability to customize announcements and LASS SLE provides the capability to customize ISDN display messages in the field.

LASS SLE is compatible with Telcordia requirements . The compatibility is achieved with the introduction of circuit pack MC5D143A3. This pack contains the full compliment of phrases needed to construct the required announcements.

10.14.3 DSU-2/RAF □ BRCS

The ability is provided for the DSU-RAF-BRCS to interact with an analog dial pulse, touch-tone, or ISDN station set to provide interactive announcements and digit collection of DNs for all the LASS selective features (LSF). The DSU-RAF-BRCS is only used during the screen list editing and feature activation or deactivation. The DSU-RAF-BRCS is not used for the individual screening of incoming calls. The screening is performed by the LSF software. Digit collection is performed by UTD for intraswitch or obtained from CCS messages for interswitch. With the 5E5 software release, a new community of DSU-2/RAF announcements is available for BRCS features. This new community (DSU-2/RAF-BRCS) is maintained and engineered separately.

The features served by this RAF community are:

- Automatic customer station rearrangement (ACSR)
- Remote access to call forwarding (RACF).

10.14.3.1 Engineering Considerations

One DSU-2 circuit pack offers the equivalent service of 20 tone decoders. Therefore, an SM equipped with a DSU-2 (containing two circuit packs - one per service group) has an operations, administration, and management (OA&M) capacity of 1,043 CCS. This is the equivalent of 40 tone decoders. Each DSU-2/RAF service group can provide up to 32 (20 in the case of the dial-through application) variable length announcements. The total amount of time available for all announcements is 1250 seconds. Two or more service groups may be provided. The standard capacities for the DSC pack in the DSU-2 apply to DSU-2/LDSUF.

The DSU-RAF-BRCS are global resources. Up to eight units can be equipped in an SM (0-7). Each unit has four service groups. Each service group requires 20 DI time slots for DSU-RAF-BRCS and 32 DI time slots for ISTF. If only DSU-RAF-BRCS is equipped in an SM, only 6¼ units (or 25 service groups) can be provided. If ISTF is included, the number of units is reduced, depending upon the number of ISTF

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provided. The DSU2-ISTF requires the loaded software configuration. Any line in an office may be equipped with LASS-screen list editing (SLE). The capacity of DSU-RAF-BRCS is shown in Table 10.14-1 for from 1 to 24 service groups. The recommended blocking in Table 10.14-1 is P0.01. The CNI ring is limited to five link pairs, digital or analog or both.

Table 10.14-1 Poisson Capacity for DSU/RAF-BRCS for RACF, ASCR, and LSS-SLE

SERVICE GROUPS PROVIDED	EQUIVALENT CIRCUITS	CCS CAPACITY P0.01
1	20	399.0
2	40	963.6
3	60	1564.5
4	80	2184.1
5	100	2815.6
6	120	3455.7
7	140	4102.1
8	160	4753.7
9	180	5409.4
10	200	6068.6
11	220	6730.8
12	240	7395.5
13	260	8062.5
14	280	8731.5
15	300	9402.3
16	320	10074.7
17	340	10748.7
18	360	11423.8
19	380	12100.3
20	400	12777.9
21	420	13456.5
22	440	14136.1
23	460	14816.1
24	480	15497.9

10.14.3.2 Assignment Guidelines

The design of the local digital service unit function (LDSUF) provides a fixed number of resources (time slots and DSPs) that must be assigned to one of four possible functions. The four possible functions are tone generation, tone decoding, tone transceivers, and CAMA tone. The assignments required are dependent upon the features in the office or on a given SM.

Time slots on the LDSU bus (LDSUB) are allocated to the DSPs via translations on the office data administration system (ODA) record 5470. On this record, DSPs can be assigned the following functions:

- Tone Generation - a maximum of 31 transmit time slots
- Tone Decoding - a maximum of 5 receive time slots per DSP
- Tone Transceiver - a maximum of 5 transmit and receive time slots per DSP
- CAMA Transfer Decoder - a maximum of 10 receive time slots per DSP.

When assignments are made to the DSPs, a total of 31 transmit time slots and 30 receive time slots can be assigned.

For maintenance purposes, DSPs should always be assigned in pairs - equal number of time slots in each of two service groups.

Figure 10.14-2 shows two assignments of DSPs that can be done on an office basis. Figure 10.14-2 A is the case where there is no VPA, AVMWI, or AICLID. One DSP is always required for UTG while the remaining six DSPs are assigned to UTD. This would provide the equivalent of 62 UTG channels and 60 UTD channels (or the maximum allowed). Figure 10.14-2 B is the case where VPA, AVMWI, or AICLID is required in the office. In this case, one DSP is assigned to UTG; five are assigned to UTD, and one is

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assigned to VPA, AVMWI, and AICLID. This arrangement provides 52 UTG channels, 50 UTD channels, and 10 transceiver channels for VPA/AVMWI/AICLID.

Assignment rules for LDSUs converted to DSU-2/LDSUF are the same as for DSU-2.

The SLE and LSF features are supported on basic, standard, and loaded SM software configurations. Each LSF can have a different maximum size list defined on the 5945 record. The minimum value for each list is recommended as 6 and the maximum value is 31. The DNs are stored as multiples of 6; thus, sizes of 6, 12, 18, 24, and 30 are optimal. The LSF is available on an individual line basis or on a global office basis. The exception is multiline hunt groups (MLHGs) which requires individual assignments. The SLF lists for MLHG is located on the SM that contains the first member (member 0) of the group and on the SM that contains the routing information for the MLHG. Both flat-rate or usage-sensitive billing is available for SLE and LSF features.

10.14.3.3 Measurements and Primary Service Indicators

The measurement in Section 46 of the TRFC30 report includes a peg count of the DSU-2/RAF circuits as follows:

- Access
- Overflow
- Maintenance Usage
- Total Usage.

10.14.4 DSU-2/RAF ASP

10.14.4.1 Engineering Considerations

There are no capacity considerations associated with this feature.

10.14.4.2 Assignment Guidelines

The DSU-2/RAF for ASP should be engineered using Poisson P.01 table. The traffic load depends upon the number of ASP calls requiring DSU-2/RAF and the average holding times for the announcement and/or digit collection. The following call types are examples of call types requiring DSU-2/RAF.

- IDDD access
- Authorization codes
- Remote access to PVN
- Call screening (originating).

A default holding time of 30 seconds should be used when measured holding times are unavailable.

Each DSU/RAF serving group provides 20 servers. The number of DSU/RAF-ASP groups required is calculated as follows:
ASP_Servers /// 20 = DSU/RAF-ASP Groups

This calculation is the number of ASP servers divided by 20 and rounded up. Each group requires 20 time slots, and the number of TSS required is calculated as follows:

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(DSU/RAF-ASP groups per SM □ 20)///32 = ASP_TSSs

This engineering results in all of the DSU/RAF-ASP groups being equipped in the same SM. If the customer wants to distribute the groups in different SMs, the Time Slot Set calculation must be performed for each SM with DSU/RAF-ASP groups.

10.14.4.3 Measurements and Primary Service Indicators

The TRFC30 Section 118 provides measurements for the ASP feature and include.

- □ Call processing failure before initial query
- □ Call processing failure after initial query
- □ Resources unavailable before initial query
- □ Resources unavailable after initial query
- □ Network management control block
- □ Signal failure due to time-out
- □ Invalid command message
- □ Invalid sequence message
- □ Return error, reject message, or return query received
- □ Abandons before outpulsing
- □ Abandons after outpulsing
- □ Inter-Local access and transport area (LATA) carrier trunks busy
- □ Service provider trunks busy
- □ ASP calls originating in the SSP
- □ ASP calls originating in the network access point (NAP)
- □ ASP calls received from a NAP
- □ ASP queries sent to a service control point (SCP)
- □ Response messages received
- □ Play announcement messages.

10.14.5 FEATURE IMPACT

In offices employing VPA, AVMWI, and/or AICLID, the use of those features has an impact on the associated DSP. The feature impact for DSPs providing TD or UTG functions are the same as described for the LDSU.

The DSU-2 cannot provide RP signaling.

10.14.6 TRANSITION IMPACT

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The DSU-2 is installed on a per SM basis. Data base changes and hardware assignments are required as previously described. Information concerning the conversion from LDSU to DSU-2 can be found in 235-105-231, *Hardware Change Procedures*. The LDSU can be converted to an equivalent DSU-2/LDSUF by removing the UTG and UTD packs and replacing the common board with a TN1637.

Figure 10.14-1 Digital Service Unit Model 2

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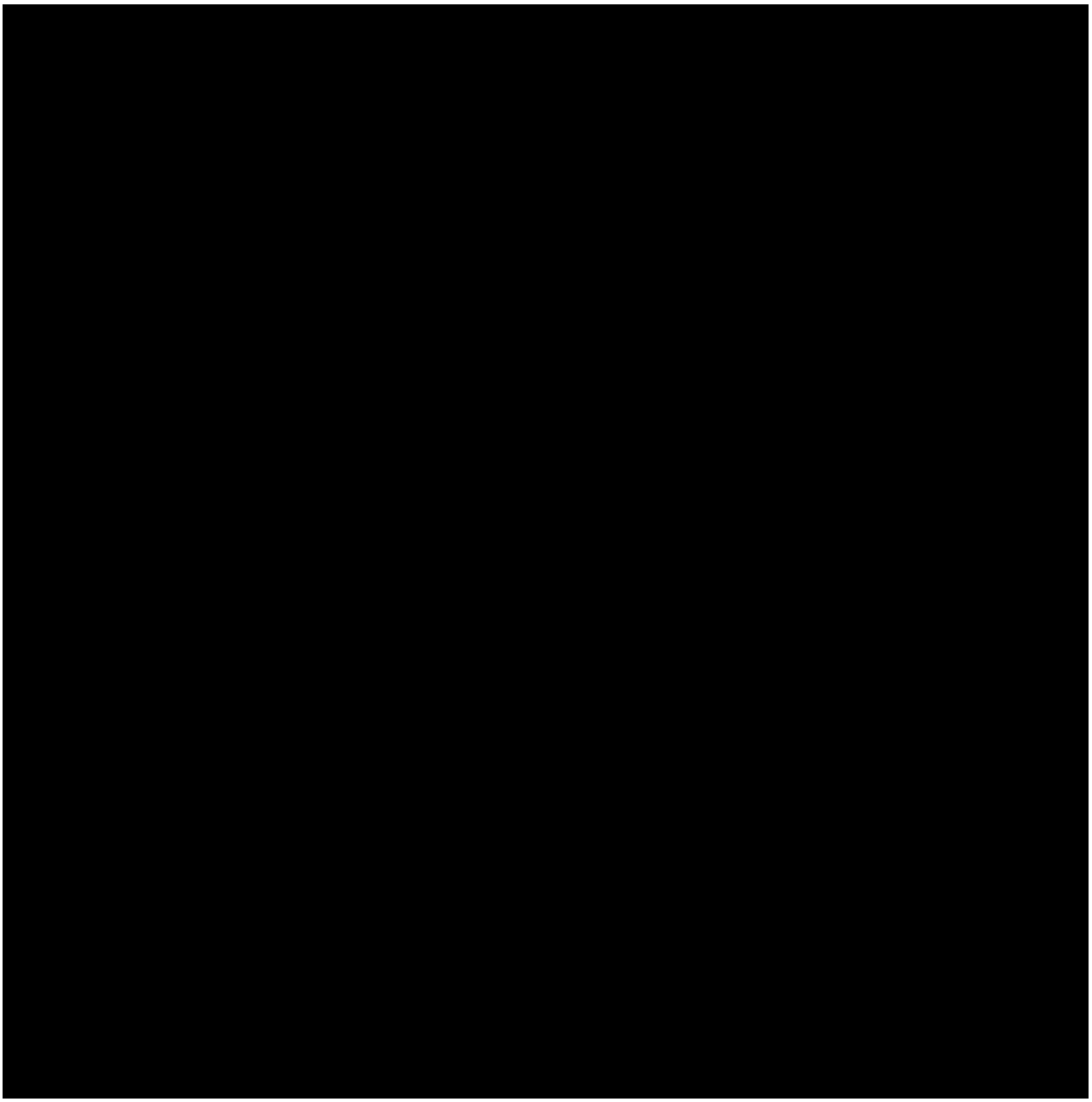

Figure 10.14-2 Recommended Assignments Per Office

10.14.7 Service Announcement System

The service announcement system (SAS) is a high capacity announcement system for the *5ESS*® switch. The SAS provides a significant increase in the number of announcements and announcement seconds supported. The SAS provides transparency with the existing RAF functionality, and can be used for dial through announcement (DTA), announcement only channel (AOC), directory assistance (DA), or COIN applications.

The SAS hardware is modified from the digital service circuit 3 (DSC3) technology. Each SAS physical service group (PSG) requires one SASDSC which interfaces with a single PIDB/PICB to provide full support for 32 announcement ports and/or MF/DTMF/Coin Detection. In addition to the SASDSC board (TN1841), a SAS PSG consists of 1 to 4 memory boards (TN1842), with each memory board containing up to 8 industry standard (PCMCIA/JEIDA) flash cards. The number of announcement seconds that can be provided depends on the flash card memory density on an individual flash card is given by:

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ANN (seconds)/CARD = (Flash Card Density (in MB) - .5 MB) □ (2^{20} bytes/MB) □ (.096 sec □ 774 bytes)

Therefore, a 20MB flash card can store 2,536 announcement seconds. The maximum announcement storage capacity per SAS PSG with 31 cards of 20MB density is 78,611 seconds (assuming one card is reserved). The SAS PSG is added to the DSU2 shelf space; no backplane changes are required.

10.14.7.1 Engineering Considerations

The following issues should be considered when deploying SAS:

- SAS/RAF PSGs can be mixed on the same DSU2 shelf in an SM/SM-2000.
- Maximum of 8 PSGs per DSU2 shelf
- Maximum of 8 SAS PSGs per SM/SM-2000.
- SAS/RAF PSGs can be mixed within a given application (for example, Logical Service Group (LSG))
- Flash cards of varying density can be mixed in the same SAS PSG, and on the same memory board
- SAS PSGs should reside only on loaded SMs.

SAS hardware technology is based on the Digital Service Circuit 3 (DSC3), developed for SM-2000. Each SAS physical service group will have 1 to 4 memory boards, with each board having slots for 8 flash memory cards. SAS Service Groups will have 1 SAS-DSC control card; The SAS platform on SM-2000 effectively increases the announcement capacity on standard SMs while remaining compatible with existing RAF hardware and announcement administration.

The memory boards are designed to handle any PCMCIA compliant flash card. The design also allows the board to operate with flash cards of varying capacity, and with 1 or more empty flash card slots. To facilitate announcement updating and emergency restoration of announcements, each flash card will store information describing the phrase data stored on that card, and data for any given phrase will not be allowed to cross flash card boundaries.

Using 20 MB flash cards, a fully loaded SAS will be able to provide over 70,000 seconds of non-compressed announcement data, the equivalent of over 60 fully loaded RAFs.

Because of RAF transparency, SAS will have as many (if not more) Announcement Headers and Phrase IDs as is used for RAF. The number of announcement headers is 64,000. Thus, SAS will be able to play over 64,000 unique announcements.

It is possible to construct SAS announcements using 67 concatenated phrases (the current RAF limit).

SAS will support 32 ports, any number of which can be configured as Dial Through Announcement (DTA) ports.

Table 10.14-2 Poisson Capacity for SAS

SERVICE GROUPS	CIRCUITS	CCS CAPACITY P0.01
1	32	731.9
2	64	1687.3
3	96	2689.2
4	128	3715.2
5	160	4755.6
6	192	5804.5
7	224	6863.5
8	256	7862.2

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10.14.7.2 Compatibility with Existing Hardware and Announcement Administration

SAS is upward compatible with existing RAF related application software and announcement administration procedures. SAS meets or exceeds the RAF's ability to provide multiple ports, interruptible and non-interruptible announcements, variable length announcements, variable content announcements, multiple playback modes, all existing tone detection (including coin and DTMF), dial-through announcements, and other capabilities provided by the RAF. SAS will also meet or exceed RAF standards of responsiveness and reliability, and be able to work under the RAF principles of announcement indexing and phrase concatenation. Thus, while new office data will be introduced, it will not be necessary to modify existing application software and recent change procedures to accommodate the SAS -- which will be able to generate announcements based on the same data stream currently used to generate announcements in the RAF.

Service Announcement Systems will be able to co-exist with RAFs in the same DSU2 housing and in the same logical service group in the SM. When combining SASes and RAFs in the same logical service group, care must be exercised to ensure that all the physical service groups (each RAF and each SAS) contain the same announcement data. If they contain different data and a trunk-hunt method is used to route to an announcement port, a port might be reached that does not have the necessary data for the intended announcement. SAS will be designed to meet general switching maintenance requirements in the areas of diagnostics, REX, repair, and fault recovery. SAS will be able to detect 95% of all faults within 1 hour of failure. Unique unit types will be used to identify the various types of SAS and RAF PSGs.

The TRFC30 Report is updated to include all relevant information for engineering SAS, similar to the DSU2-RAF. This information includes peg and overflow counts for circuits by announcement application type. The affected TRFC30 sections are 44, 46, 64, 100, 101, 102, and 146.

10.14.7.2.1 SAS Administration Workstation

The Service Announcement System (SAS) provides announcements for *5ESS*® switch applications. In conjunction with the SAS, a workstation is needed to administer announcements. Customers have expressed a desire for a workstation in order to administer their own announcements.

A workstation is provided with an interface to a unit that allows individual flash cards to be written. This unit fits in the same space as a floppy disk drive on a PC. This requires flash memory cards to be written and then installed into the SAS unit on the *5ESS*® switch. Using this procedure, the SAS unit must be removed from service for a short period. However, since the SAS is engineered to allow for outage of individual units, this should not cause call service disruption.

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10.15 RECORDED ANNOUNCEMENTS

10.15.1 DESCRIPTION

The recorded announcement arrangements provided for the *5ESS*® switch are provided by 13A, 14A, 15A, 16A, 17A, and 18A Announcement Systems, Record Announcement Function (RAF) and Service Announce System (SAS), and software combinations for supplying information to customers through the use of recorded announcements. Announcements are used to inform customers and operators of certain conditions. Calls can be terminated to an announcement in one of two ways. First, a call can be directed to an announcement by the call originating process. Secondly, a call can be connected to an announcement if the routing and terminal allocation (RTA) program cannot complete the routing of the call. The following types of announcements may be provided:

- Dial-tone-first (DTF) coin
- Local coin overtime
- Partial dial
- Permanent signal
- No 1+ dialing error
- Invalid digit
- Extra 1+ dialing error
- Custom calling error
- Vacant code
- Emergency overload
- Coinless public telephone (Charge-a-Call).

Additionally, intercept announcements may be provided by way of trunks to the automatic intercept system (AIS).

Nine optional announcements are available for local area signaling services (LASS). Three announcements (13A type) are associated with customer-originated trace (COT), and six announcements (13A type) are associated with AR/AC (automatic recall and automatic callback).

The three announcements for COT are:

- Successful activation of COT request
- COT not available announcement
- COT buffer full announcement.

The six announcements for AR/AC are:

- AC confirmation announcement
- AR confirmation announcement
- AR/AC time-out without completion of AR/AC request announcement

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- AC cancellation announcement
- AR cancellation announcement
- AR/AC party busy announcement.

Route index for these announcements are defined on 5945, LASS Office Parameters Form, and 5303, Route Index Form.

The call forwarding over private facilities (CFPF) feature is available to customers with the ability to use the call forwarding variable (CFV) feature to forward calls over private facilities or services. These private facilities selected by the customer may include; foreign exchange (FX), outward wide-area telecommunications (OUTWATS), common control switching arrangement (CCSA), senderized tie trunks, or automatic route selection (ARS). The CFPF announcement, which is optional for the CFPF feature, is a non-dial-through announcement using the 13A Announcement System.

Local announcements may be provided by a recorded announcement unit (RAU) which employs the 13A Announcement System. Announcements may also be provided by the 14A Announcement System. The DSU-2/RAF may by used to provide Operator Services Position System (OSPS) announcements. The feature control (FC) software subsystem within the *5ESS*® switch establishes the connections between the customer line and the announcement facilities.

The DSU2-RAF service group offers custom announcements. The custom announcement capability allows the service provider to selectively customize specific phrases that are linked together into an announcement. Additional instructions or advertisements may be placed at the beginning or end of standard announcements. The term "phrase" refers to a tone, word, or group of words used for announcement construction. The term "announcement" refers to the linked together set of phrases that form the entire audible announcement.

Each RAF service group is equipped with a TN1053 announcement storage circuit. This circuit contains standard phrases for the particular feature that the RAF services. Standard phrases are encoded speech that has been digitized and edited. Each RAF service group also has two expansion ports for expanded phrase storage. The expansion ports are controlled by the TN1053 and may contain a TN1054 expansion announcement storage circuit. The TN1054 circuit contains standard phrases and is used for feature needing large memory.

The custom announcements are available both as audible announcements and as integrated service digital network (ISDN) display messages. Although the Telcordia TR222 only applies to audible announcements, the ISDN display messages have been changed to be consistent with the Telcordia requirement. These additions can be ordered as a list that will be delivered on the custom pack. An equivalent set of changes for the ISDN display also exists. A recent change/verify (RC/V) view 8.65 (DISPLAY MESSAGE) was added to manage the display messages.

A call can be connected to an announcement for up to 240 seconds before it is disconnected by the switch.

For more details on the DSU2-RAF custom announcements refer to 235-190-115 - *Local and Toll Feature Description* s.

SAS provides functions that are similar to the RAF. It is capable of providing a large increase in the number of announcements, as well as the length of announcements that are available.

10.15.1.1 13A Announcement System

The main component of the RAU is the 13A announcement machines which are located in the miscellaneous cabinet. This is a totally electronic storage device which uses semiconductor memory to store a recorded message in digital form. It has a capacity of 100 simultaneous calls. There are no moving

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parts in this announcement machine. A maximum of four 13A announcement machines may be installed in a miscellaneous cabinet.

Each 13A announcement machine has the capability to provide up to eight channels of recorded messages; each of which provides a single recorded announcement. The circuit packs which contain the circuitry to provide a recorded announcement are called message modules. There are two types of message modules that provide the following:

(a) Variable message length (3 to 24 seconds)

(b) Variable message length (3 to 12 seconds).

The recorded announcement interface uses 4-wire E&M trunk circuit packs. This interface converts each of the announcement channels from analog to pulse code modulation (PCM) and sends the data to the time slot interchanger (TSI) for distribution. When a call is to be routed to an announcement, a connection is made between the calling party and the trunk circuit by way of the TSI. The recorded announcement interface is a non-barge-in type of announcement. For any *5ESS*® switch that provides the CFPF service , a 13A Announcement System is required.

10.15.1.2 13A+ Announcement System

Each 13A+ Announcement System supports up to 8 announcement channels. Each announcement channel can contain an announcement of 30 seconds, 1 minute, 2 minutes, or 4 minutes. The 13A+ has a remote recording interface allowing the service provider or customer to change the recorded announcement from a remote location.

NOTE: The 13A+ Announcement System replaced the 13A Announcement System.

10.15.1.3 14A Announcement System

The 14A Announcement System provides announcements in a manner similar to the 13A Announcement System. Additionally, the 14A Announcement System provides a line-side announcement capability which is particularly applicable to remote switching module (RSM) installations.

The 14A is a microcomputer-controlled electronic announcement system which uses a multipulse predictive coding (MPLPC) speech synthesis algorithm to generate high quality speech. The announcements may be preceded by special information tone (SIT) encodings. The digital data required to generate the speech and the SIT encodings is stored in erasable, programmable, read-only memory (EPROM) which is mounted on a plug-in module.

The 14A Announcement System has two plug-in modules, each having a dedicated announcement channel when the interface is on the line side (2-wire telephone line). Each of these channels can handle a single call. Therefore, only two calls may be connected to the announcement system at a time. When interfacing the trunk side, each channel can handle up to 32 calls.

The playback only announcement module provides a single announcement of up to 26 seconds in length depending on the type of EPROM (128 K-bit or 256 K-bit) installed. The system has a 2-channel capability with each channel providing a specific announcement. The announcements are changed by unplugging the installed module and plugging in another module containing the new announcement. The playback only announcement modules are preprogrammed to provide the specific message desired. The record/reproduce (R/R) announcement modules are programmed by the service provider to provide the specific message desired. The R/R modules provide a single announcement of 30 or 120 seconds.

Since the 14A system is completely electronic, no routine maintenance is required. An on-board microcomputer routinely performs diagnostics on both the plug-in module and the announcement channel circuitry.

In a stand-alone-RSM situation, originating calls destined to terminate to lines outside the RSM may be

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routed to the 14A Announcement System. Ten seconds after completion of the announcement, the call is disconnected and the caller receives dial tone.

10.15.1.4 15A Announcement System

The 15A Announcement Service is a circuit with 8 channels of announcement service. Two circuit packs can be mounted side-by-side to create a 4, 8, 12, or 16 channel system. The 15A Announcement Service uses CMOS electrically erasable programmable read only memory (EEPROM) technology to provide effective, non-volatile recordings (without batteries). The 15A Announcement Service also has a remote recording interface allowing the service provider or customer to change the recorded announcement from a remote location.

The manufacture of BLD1, BLD2 and 400A has been discontinued.

The 15A Announcement Service has the following circuit packs giving the user flexibility in recorded announcement service:

BLD3 A record/reproduce unit that uses EEPROM memory and can record up to eight unique announcements of up to 60 seconds in length each.

BLD4 A record/reproduce unit that uses EEPROM memory and can record one unique announcement of up to 60 seconds in length each. The recorded announcement is copied in all 8 channels of the BLD4 unit. The announcements are played back continuously in "phased" (cascaded) mode.

BLD5 A record/reproduce unit that uses EEPROM memory and can record up to eight unique announcements of up to 120 seconds in length each.

BLD20 A record/reproduce unit that uses EEPROM memory and can record up to four unique announcements of up to 60 seconds in length each.

BLD21 A record/reproduce unit that uses EEPROM memory and can record up to eight unique announcements of up to 60 seconds in length each. Each channel is equipped with ring-trip circuitry and can be connected to a telephone line.

400B Provides voice prompting in addition to an option for tone prompting. This unit supersedes the 400A unit which only provided tone prompting.

Refer to Lucent Practice 201-522-101, *15A Announcement System Description and Operating Procedures Common Systems* for more information.

10.15.1.5 16A Announcement System

The 16A announcement system is a digital record and playback system that provides up to 24 broadcast announcements for central office switches and for Network Wireless Systems Mobile Switching Centers. It interconnects with the switch using DS1 or E1 digital trunk facilities. The 16A can also be configured to provide 20 recorded announcements and four channels with an external audio source for music on queue or music on hold.

Each 16A is equipped with one BLD10 digital interface circuit pack and up to three announcement circuit packs. The BLD10 encodes, frames and formats the analog announcements into either a DS1 signal with D4 format and AMI line or into an E1 signal.

Three different types of announcement circuit packs are available, each of which may be equipped with the optional 400B remote record module.

BLD3 Eight one-minute announcements.

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BLD4 Eight one-minute cascaded or phased announcements; one announcement is recorded automatically on all eight channels. The starting times for the eight announcements are spaced apart by approximately 1/8th of the announcement length. The BLD4 is typically used with automatic call distributor (ACD) applications.

BLD5 Eight two minute announcements.

400B A dial-up remote record module that mounts on top of each of the BLD3, BLD4, or BLD5 circuit packs.

The 16A is modular in design and can be equipped with 1, 2, or 3 circuit packs in any combination of the BLD3, BLD4, or BLD5 packs.

Each announcement is stored on a non-volatile chip so the announcement is not lost when power is removed. A new announcement can be recorded over an existing announcement as often as necessary.

The central office switch delivers each announcement to as many as 60 callers simultaneously. Thus, 24 announcements can be heard by as many as 1440 callers at any one time.

For more information about the 16A announcement system, refer to Lucent practice 201-523-101, *16A Announcement System Description and Operating Procedures*.

10.15.1.6 17A Announcement System

The 17A announcement system is a digital announcement system with storage capacity for up to 166 announcements. The 17A interconnects with a digital switch using one DS1 or E1 digital facility that provides 24 or 30 trunk channels, respectively. The DS1 signal uses the D4 format and AMI line coding.

The 17A provides an effective way to manage a large number of announcements on a limited number of trunk channels. Each caller may listen to any one of 166 unique announcements or all 24/30 callers may listen to the exact same announcement but with different announcement starting times depending on when the caller was connected to the trunk channel.

The maximum length of the announcements recorded on the 17A is flexible. The memory space for the announcements is allocated as follows:

- 121 announcements up to one minute each.
- 30 announcements up to two minutes each.
- 15 announcements up to four minutes each.

Any 17A announcement can be used as an immediate start announcement or as a broadcast announcement or as both at the same time depending on how the 17A is programmed by the administrator.

Immediate Start Lengthy announcements can be effectively delivered to callers without delays in playback. The playback of a requested announcement occurs immediately. If the caller hangs up before the end of the announcement, the 17A disconnects and the trunk channel becomes available for the next caller.

The 17A plays immediate start announcements over interoffice trunk channels, e.g., LTOLLCON trunks in *5ESS*® switches, in response to a three digit MF code from the switch. The MF code transmitted to the 17A identifies which one of up to 166 announcements to play.

Each of the 166 announcements used for immediate start service can be set for either

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answer supervision or no-answer supervision. If the signaling type is set for answer supervision, billing is triggered when the announcement is played back to a caller. The call is disconnected upon completion of the announcement playback. If the signaling type is set for no-answer supervision, billing is not triggered when the announcement is played back and the 17A sends reorder (trunk busy) until the caller disconnects.

Broadcast A network announcement stored on the 17A can be linked (or nailed up) to a specific announcement trunk channel for broadcast to multiple callers. An MF code does not have to be transmitted to the 17A to identify which announcement to play. But an announcement must be assigned to a placeholder MF code for the 17A to place the announcement in service. The 17A plays the broadcast announcement continuously. The 17A sends a start signal to the switch at the beginning of the network announcement each time the announcement plays. The *5ESS*® central office domestic switch delivers each broadcast announcement to as many as 60 callers simultaneously.

For announcements linked to announcement trunk channels, the signaling type does not have to be set to a specific state as this information is not used by the switch.

Trunk channels are numbered from 0 to 23 and correspond to time slots 1 to 24 on the DS1 facility.

Each announcement is stored on non-volatile flash memory cards therefore, the announcement is not lost when power is removed. A new announcement can be recorded over an existing announcement as often as necessary after erasing the old announcement.

For more information about the 17A announcement system, refer to Lucent practice 201-523-201, *17A Announcement System Description and Operating Procedures*.

10.15.1.7 18A Announcement System

The 18A announcement system is a general purpose, one-channel, two message announcement unit. It provides audio record, storage and playback announcement service for use with telecommunications systems applications. The 18A is designed to interface with the following:

- a conventional analog two wire tip and ring telephone line interface.
- the Lucent Technologies Call Management System (CMS) for *MERLIN*® and MERLIN LEGEND.
- Contact-activated start (CAS) and on-hold systems.

Two versions of the 18A announcement system are available. They are:

Table 10.15-1 18A Announcement System

Version	No. of Announcements	Total Recording Length	Remote Access	External Announcement Selection [a]
Model A	2	210 seconds	Yes	Yes
Model B	2	70 seconds	No	Yes

Notes:

a. External switch not required. (not provided).

The 18A announcement system provides the following:

- Two announcements may be stored for playback to callers. The announcement memory is 210 seconds long for Model A or 70 seconds long for Model B. The memory can be partitioned in four different ways to accommodate two announcements of different lengths. Either one of the

announcements may be selected at a given time.

- Announcements may be recorded from a telephone handset, a pre-recorded cassette tape or, optionally, a remote location over a telephone line.
- Announcements may be monitored via the telephone handset, or optionally, from a remote location over a telephone line.
- Announcements are stored using EEPROM technology that does not require batteries to retain the announcements during power failure.
- To facilitate installation, two 10 second announcements are prerecorded on each 18A at the factory
- All 18A systems include an external announcement selection feature where an external switch (not provided) or contact closure can be used to change the active announcement.

The Model A version includes remote access capability which is provided over the analog tip/ring line interface. This feature takes advantage of the already existing line interface circuitry and can be used whenever the tip/ring circuit is idle. The unit can be accessed from a remote location via a touch-tone telephone. Either voice or tone prompts can be used to guide the user through the remote access session. Using the telephone's touch-tone keypad, the user enters a security code and a series of commands to record and monitor announcements.

Refer to Lucent Practice 201-523-301, *Global Business Communication Systems 18A Announcement System Users Guide Description and Operating Procedures* for more information.

10.15.2 ASSIGNMENT GUIDELINES

10.15.2.1 General

For each announcement that terminates on a trunk, the *5ESS*® switch can fan out only 32 callers onto one announcement trunk or to reorder. If one announcement channel is repeatedly used in a high volume (greater than 32 simultaneous calls), try to spread the overflow to the same announcement in another trunk unit in a different SM. The announcements are assigned on a per-system basis. In some cases, the operating telephone company may have a choice to provide reorder tone instead of an announcement. This provides an equipment choice in terms of announcement facilities, but it provides more load on the tone generators.

All locally provided announcements can be provided on either a barge-in or non-barge-in basis. It is recommended that all announcements except the emergency overload announcement be provided on a non-barge-in basis. The software release selects the announcement circuits based on the type of announcement required. The telephone company must assign that announcement on a barge-in or non-barge-in basis, as desired.

In the case of the RAU, the assignment of announcements involves the use of trunk circuits in the trunk unit (TU) which is described elsewhere in this manual. Details concerning the assignment of trunk circuits can be found in Translation Guide TG-5 and 235-118-200 - *Recent Change Procedures Menu Mode* or 235-118-202 - *Recent Change Procedures Text Interface.*

In the case of the 14A Announcement System, the announcement may be provided by line-side or trunk-side connections. If a line-side application is employed, a directory number (DN) must be assigned to each of the announcement channels, and the ports must be defined in the office dependent data (ODD). Additionally, both lines should be in a uniform call distribution (UCD) hunt group. Refer to the descriptions of the line unit (LU) and the RSM elsewhere in this manual in addition to the TG-5 and recent change documents for details concerning the assignment of line equipment.

The CFPF, ACSR, and RACF features will not affect the present load balance assignment rules for analog

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or digital lines.

Once the new phrases are added to either a new office or to a retrofitted office, the line assignments can be made for the feature that uses the new announcements. Customized announcement lengths that are appreciably longer than standard announcements have an effect on traffic engineering.

When the queuing feature is used as part of the MLHG call scenario, announcement circuits that occupy only one time slot on the peripheral side can occupy up to 20 time slots on the network side. These 20 time slots are occupied by the queued calls. Spread or provision each queuing trunk to occupy 20 time slots on the peripheral side if engineering did not provide adequate time slot sparing.

10.15.3 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

10.15.3.1 General

Measurements associated with the DSU-2/RAF are contained in Section 46 of the TRFC30 report. These measurements are counts of total access, overflow, maintenance usage, and total usage. Refer to 235-600-750, *Output Messages Manual* for further discussion of these measurements.

No additional measurements are provided with the CFPF feature. This data may be collected in TRFC30, Section 29, business residential customer feature, and Section 30, terminal group measurements. Measurements for each announcement is located in TRFC30 Section 12.

10.15.4 FEATURE IMPACT

The use of features or the implementation of new features generally have no impact on the recorded announcements. An exception to this is the implementation of the Carrier Interconnect (CI) feature. The implementation of the CI feature may involve additional announcements specifically developed to support calls involving the use of carrier facilities. These announcements are optional; and if provided, may require additional announcement frames and/or additional announcement machines.

In addition, the line Time Slot Bridging Port (LTSB) Inter Work with Home Intercom (99-5E-7178) feature may impact recorded announcements. Refer to Section 2.3.1.4 for more information.

10.15.5 TRANSITION IMPACT

Additional recorded announcements are implemented through the addition of new message modules, new announcement machines, or in some cases, the addition of new miscellaneous frames. Recent change procedures are required to make the new announcements available for use. The addition of new announcement facilities has no impact on existing announcement facilities. For further details concerning this growth procedure, refer to the following documents:

- 235-118-XXX - *Recent Change Procedures*
- 235-105-231 - *Hardware Change Procedures*
- 235-600-30X - *Equipment Configuration Data*
- 235-190-115 - *Local and Toll System Features.*

Custom announcements are provided on a TN1054 that resides in one of the expansion slots in the DSU2-RAF. To order custom announcements, fill out the order form obtained from DOPSMOD engineering information and attach the form to the telephone equipment order. The J-drawing J5D003EA-1 lists 15A and MA-MK are available to order standard announcements and messages as well as Telcordia and customized changes. SAS is provided on the TN1841 and TN1842 boards.

In a retrofit environment, standard packs and messages should be installed before the retrofit. This can be

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done by growing the standard announcement packs and assigning a telephone number to an ISDN SM before the retrofit. Lucent Technologies then maps the standard announcements and messages during the retrofit process. After the retrofit, the custom pack can be grown and the RC/V tape and script can be loaded. The custom pack can also be grown prior to the retrofit. The announcements may now be customized. As a general rule, the standard announcements and messages must be in the software before customizing can proceed. Also, before the tape can be loaded, RC/V View 8.64 (ANNOUNCEMENT APPLICATION SM LIST) must be completed. RC/V View 8.64 shows the applications(s) and the SM(s) that contain the RAF hardware.

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11. RSM UNIQUE RESOURCE UTILIZATION

11.1 DESCRIPTION

The remote switching module (RSM) is a switching module (SM) located remotely from a host *5ESS*® switch office and connected via T1 carrier, digital radio, and/or fiber optics. Figure 11-1 provides a simplified block diagram of typical RSM interconnections to the *5ESS*® switch office. The RSM can terminate a maximum of 5,120 analog lines at a 10:1 concentration ratio (although this is not normally recommended). This number assumes no trunks and no optional equipment such as announcement machines which require trunk units (TUs). More realistic maximums when trunking and optional equipment are included are approximately 3,000 lines for the single-module RSM. The following conditions reduce the number of lines that the RSM can terminate:

- Lower concentration ratios such as 8:1 (4,096 lines), 6:1 (3,072 lines), or 4:1 (2,048 lines)
- Terminating pair gain systems
- Providing local announcements, remote testing capabilities at the RSM, or private branch exchange - direct inward dialing (PBX-DID) trunks
- Each TU provided reduces the line capacity.

The function of the RSM is to provide the switching capabilities of the *5ESS*® switch to areas that cannot economically support an *ESS*™ switch. The RSM offers custom calling features to areas normally served by community dial offices (CDO) or small wire centers. In addition, the RSM performs switching functions for large pair-gain systems.

The RSM has additional software that enables the RSM to operate if control links to the host SM fail. The RSM can share the normalized office code designation of the host *5ESS*® switch if the wire center is within the same rate area. If the wire center is not within the same rate area, a dedicated normalized office code that is separate from the host must be assigned.

The RSM has the following characteristics:

- Provides the same service as a host SM
- The ability to transmit traffic and other administrative data to the host office
- A zero resistance point for the loop plant
- Intraswitching of local RSM calls
- Stand-alone capability to provide autonomous local switching if facilities at or between the host office and the RSM fail
- Single-route access via the host office to the toll network as well as to other local offices
- A dedicated normalized office code, if required
- Access to all operating support systems available to the host office.

The RSM offers capabilities to terminate analog lines and pair gain systems such as the *SLC*® 96 carrier system and provides all the features available at the host SM.

The RSM consists of standard SM cabinets. However, the RSM uses a facilities interface unit (FIU) to convert data received from the host office. The function of the FIU is to recover data, control, and timing

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information from the T1 line and to format this information into a pair of network control and timing (NCT) link signals.

All trunk types supported by the *5ESS*® switch host office are also supported by the RSM.

The single-module RSM refers to a single-remoted SM connected to the host *5ESS*® switch by T1 carrier or other transmission facilities.

11.2 HOST TO RSM/ORM/EXM-2000 DISTANCE

In order to meet transmission performance requirements, the RSM must be within 150 miles of its host *5ESS*® switch. If a *SLC*® 96 carrier system is hosted by an RSM, the maximum combined distance from the host *5ESS*® switch to the *SLC*® 96 carrier system is 120 miles (that is, host *5ESS*® switch to RSM distance plus RSM to *SLC*® 96 carrier system distance). The distance limitations for the EXM-2000 are identical to the RSM/ORM. The Far Access Remote (FAR) feature enables Remote Switching Modules to be located at greater distances from the host Switching Module. With this feature, RSM and EXM-2000 can be placed up to 600 miles from the host.

11.2.1 TRANSMISSION CONSIDERATIONS

For further information about transmission considerations concerning the distance between host office and RSM/ORM/EXM-2000, see 235-900-1XX.

11.3 TRANSMISSION FACILITIES

Transmission facilities other than copper T1 cable (or T1 compatible) can be used for the umbilical links. The transmission facilities include:

- Fiber optic
- Digital radio.

11.3.1 OPTICALLY REMOTED MODULES (ORMs)

The term optically remoted module refers to standard SMs of the *5ESS*® switch whose four NCT links are "stretched" via various optical and electrical transmission equipment beyond the constraints of the *5ESS*® switch location. The ORM provides all customer services at the remote location as is provided by the host switch. In this case, the interface to the *5ESS*® switch is made at the communications module (in the form of NCT links) instead of at a host SM (in the form of RSM umbilicals) as is required for an RSM.

AN ORM/2-mile ORM (ORM/TRM) feature enables sharing of the alarm status circuit (ASC), directly connected test unit (DCTU), and modular metallic service unit (MMSU) among ORM/TRMs that are located in the same building.

11.3.1.1 ORM Using Transmission Rate Converters

The lightwave termination and multiplex assembly (LTMA) equipment is available and can be used to multiplex up to 28 T1 facilities into a single DS3 rate (44.736 MB/s) channel for optical fiber transmission. This equipment can be used in lieu of the copper T1 cable for the RSM umbilical.

Transmission rate converters are required at the *5ESS*® switch and the ORM to provide the conversion from the transmission rate of the communications module (32.768 MB/s) and the DS3 facilities (44.736 MB/s). This configuration is shown in Figure 11-2 .

Fiber regenerator technology offers a wide variety of transmission systems allowing communication links

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up to hundreds of miles. Consequently, the distance limitation due to a fiber link is based on the listener echo requirements. The recommended maximum *5ESS*® switch host to RSM distance using a fiber connection is 150 miles. Note that the fiber-optic repeaters must be located in a temperature controlled environment.

11.3.1.2 TRCU2

The transmission rate converter unit - model 2 (TRCU2), can be configured to support either clear channel DS3 electrical signals (TRCU2-E), or high rate (90 MB/s) optical signals (TRCU2-O). The TRCU2 allows ORMs three different versions of host/remote transmission interfaces:

- A 2-mile optical remote switching module (TRM) which is an SM using extended NCT links with more sensitive optical receivers.
- The 120 to 150-mile ORM utilizes a transmission rate converter unit (TRCU) or a TRCU2-E (DS3 connect option) at each end of the NCT links which allows it to interface to standard transmission facilities for the remote and host connection.
- The 44 mile version of the ORM uses a 90 MB/s multiplexed TRCU2-O (fiber connect option).

11.3.1.3 TRCU3

The TRCU3 featureprovides the capability to remote an EXM-2000 or an Optically Remoted Switch Module (ORM). The TRCU3 incorporates circuit packs that support the conversion of NCT/NCT2 *5ESS*® switch signals into STS1. These circuit packs are used along with circuit packs derived from the DDM-2000 OC-3 multiplexer creating a new unit called TRCU3. The TRCU3 is capable of terminating an NCT or NCT2 link and capable of generating a SONET signal output. the TRCU3 is a replacement for the existing TRCU2 functionality, which is being manufacture discontinued, the TRCU3 provides additional capability. This capability is being implemented with a circuit pack (NCT or NCT2) which occupies a DS3 function slot in the DDM-2000 OC-3 Multiplexer. For this development, the TRCU3 created shall be equipped with either the NCT or NCT2 circuit packs and a base of DDM-2000 OC-3 packs (OLIU, OHCTL, SYSCTL, TGS). The following distinctions should be note

- The TRCU3 unit equipped with the NCT packs and the base of DDM-2000 OC-3 packs are used to remote ORMs. The NCT circuit packs terminate NCT links from the Communication module or from the ORM.
- The TRCU3 unit equipped with the NCT2 packs and the associated DDM-2000 OC-3 packs will be used to remote EXMs. The NCT2 circuit packs terminate NCT2 links from the Communication Module or the EXM.

11.3.1.4 2-Mile ORM

If the ORM can be positioned within 2 miles of the *5ESS*® switch, fiber-optic links can be provided without the need for transmission rate converters or DS3 rate transmission facilities. In this case, the usual NCT links are simply extended up to 2 miles. The 2-mile ORM configuration is shown in Figure 11-3 .

11.3.1.5 44-Mile ORM

The 44-Mile ORM provides a transmission interface between the *5ESS*® switch and an ORM, therefore achieving significant savings in transmission facilities over the standard DS3 interface. It provides a point-to-point connection of ORMs to the CM of the *5ESS*® switch using the TRCU2-O configured to drive optical fiber. Configured this way, the TRCU2-O will convert the 32 MB/s NCT rate to the 45 MB/s DS3 rate and multiplex the two DS3 channels (odd and even time slots from one physical CM) onto a single 90 MB/s channel. The output of this channel can drive a single-mode fiber link (without repeaters) for a

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distance of 44 miles without any transmission loss, depending on the specific driver pack used. The 44-mile ORM configuration is shown in Figure 11-4 .

11.3.1.6 Digital Radio

Digital radio (6 GHz) may also be used to provide the link between the host *5ESS*® switch and the RSM. The maximum distance allowed between the host and the RSM with digital radio carrier is 150 miles. With digital radio, the distance limiting factor is not due to echo path delay requirements, but instead it is limited by the performance objectives. Performance impairments include multipath fading, obstruction fading, and equipment outages.

11.3.1.7 Extended Switch Module 2000

The Extended Switch Module 2000 (EXM-2000) is an optically remote SM-2000, somewhat analogous to the ORM in the SM configuration. The EXM-2000 supports optional stand alone capability and an optional Stratum 3 clock capability and is remoted from a CM2 using QLIs, NCT link formatted fiber optic, and TRCU2 equipment.

11.3.2 HSM Feature Requirements

The HSM-2000 feature provides the capability to remote an RSM from a host SM-2000 via standard 24 channel T1 lines. The HSM-2000 uses 24 channel T1 lines to subtend the RSM, and is an evolution of the HSM, intended to extend all the services provided by a HSM to a greater number (30) of RSMs, compared to the maximum of 5 RSMs that the existing HSMs can subtend. This development is only concerned with the operation of an SM-2000 as host to RSMs. Existing single module or multi-module RSMs must be supported by an HSM or an HSM-2000 with identical functionality, both in linked and stand-alone operation. As with HSM, the HSM-2000 is the interface between the subtending RSMs and the Communications module in the host office. The HSM-2000 must provide a conduit for timing and control links to the subtending RSMs, and also provide access to the network. In practice, the timing source for the RSM is done at the Facility Interface Unit, (FIU), and the role in this for the HSM-2000, as with the SMs, is to ensure that at the near end, the HDFIs are initialized/synchronized; the T1s umbilicals terminating on the HDFIs provide input to the RSM timing selection process.

For control, the HSM-2000 will, like its counterpart, route the Control Time Slots (CTS, two active or two active with two standby per RSM) to the RSMs. Since an HSM-2000 can subtend up to 30 RSMs, it must be capable of administering the Control Time Slots for the RSMs. (MM)RSM stand-alone operation must work in an HSM-2000 environment as it does in a HSM environment. This capability extends the current ability of HSMs to support a maximum of 5 RSMs each of which is subtended from 2 to 4 standard T1 lines. It must be recognized that any RSM may be subtended from the HSM or HSM-2000 by from two to twenty T1 lines, with 4 T1 lines being typical. To subtend 30 RSMs from an HSM-2000, the minimum of two T1 lines must be enforced. 4 T1 links used to subtend an RSM from an HSM is typical in the field. A few cases will be encountered in which an RSM requires up to the maximum of 20 T1 lines to the host. The HSM is capable of supporting a cluster of 4 RSMs, this capability must be maintained for the HSM-2000. HSM-2000 must be capable of reconfiguring (up to all) the control paths to the subtended RSMs without loss of call processing capability and without going into overload. The umbilical link interface between the single module or multi-module RSM and HSM-2000 will be the same as for the existing HSM.

- The basic transport rate to support the RSM must be T1 interface (US).
- The number of umbilical links per RSM (2 - 20 T1 links) must be the same for HSM or HSM-2000.
- All the umbilical link interface from a given RSM must terminate on the same HSM or HSM-2000. Different RSMs within an MMRSM must be able to terminate their umbilicals on either the same HSM or HSM-2000.

MCC displays which contain HSM information will display similar information for HSM-2000. Currently

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identified MCC displays which are impacted include the DLTU page (112Y), this page displays all the RSMs (by RSM number and site number) remoted from the HDFI facilities also listed on this page. Information for up to 10 RSMs can be displayed currently, this is increased to display up to 30 RSMs. HSM-2000 must be displayed on MCC pages as HSM. On a call involving an HSM-2000 and its subtending RSM(s), Utility Call Trace must be capable of displaying on the MCC all the hardware the call traverses. A Utility Call Trace involving an HSM-2000 and its subtending RSM should display on the MCC all the links the call traverses.

11.3.2.1 Limits and Restrictions

HSM-2000 hardware and software must support all the applicable functionalities supported by SM-2000 in 5E10. During normal operations the HSM-2000 must provide subtending RSM(s) access to host office-based features, control and timing. In 5E10, parity with HSM functionality must be achieved by HSM-2000. The number of RSMs containing Inter SM packet nailups under an HSM-2000 must be scaled up to a maximum of 30 RSMs. The HSM-2000 without ISDN must be capable of supporting from 0 to a maximum of 30 RSMs with ISDN. The number of RSMs containing Inter SM packet nailups under an HSM-2000 must be scaled up to a maximum of 30 RSMs. Recent Change will allow ISM nailups on all 30 RSMs under an HSM. Thus an HSM-2000 without ISDN must be capable of supporting from 0 to a maximum of 30 RSMs with ISDN.

ISM nailups in an RSM under an HSM-2000 will be provided on all SM configurations supported by the HSM. These configurations are:

RSM -> RSM over ICLs

RSM -> HSM-2000 -> LSM/ORM/HSM

RSM -> HSM-2000 -> HSM/HSM-2000 -> RSM

ISM nailups in an RSM under an HSM-2000 will be provided on all SM-2000 configurations which support ISDN. Those configurations are:

RSM -> HSM-2000 -> LSM-2000 (supporting ISDN)

RSM -> HSM-2000 -> EXM-2000 (supporting ISDN)

RSM -> HSM-2000 -> HSM-2000 (supporting ISDN)

RSM -> HSM-2000 -> HSM-2000 (supporting ISDN) -> RSM

Adding ISDN to an SM-2000 is planned in the 5E10 time frame. This requirement depends on the presence of the ISDN on SM-2000 feature.

Since the HSM-2000 can have up to 30 RSMs instead of the 5 RSMs (6 times the RSMs) but the HSM-2000 has 5 times the processor speed, the time needed to send the restoral requests to 30 RSMs will not significantly exceed the existing HSM time.

The scheduling of ISM nailup restores within the RSM is the same regardless of whether the RSM is under an HSM or an HSM-2000. The actual restoral times of the ISM nailups is dependent on the HSM-2000s ability to handle call processing requests from 30 RSMs. Therefore, any requirements on call processing completion rates for half calls routed through the HSM-2000 may also affect ISM nailup restore times.

An ISM nailup from an RSM through the HSM/HSM-2000 to another SM within the switch uses existing call processing code and primitives to establish an HTP (Host Terminal Process) for the half call routed through the HSM. This HTP is present as long as the ISM nailup is in-service. The HTP monitors the ISM

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nailup connection and handles the following events:

- MGINTERRUPT message - the HTP sends channel discontinuity across the umbilical to the RSM, sends E-bit discontinuity across the TMS to the other SM, releases all data and hardware associated with its half call, and performs an OSSUICIDE.
- E-Bit Discontinuity from TMS - the HTP is notified if E-bit discontinuity is detected by the TMS and responds by sending channel discontinuity across the umbilical to the RSM, releasing all hardware and data associated with its half-call, and performing an OSSUICIDE.
- Channel Discontinuity from Umbilical - the HTP is notified if channel discontinuity is detected on the umbilical (T1 channel connecting RSM to HSM) and responds by sending TMS E-bit discontinuity to the other SM and releasing all hardware and data associated with its half-call and performs an OSSUICIDE.

ISM nailups that are out-of-service in an RSM, due to NLI or NCT link hardware problems in its parent HSM-2000, must be triggered for restoral when the HSM-2000 hardware problems clear. The HSM-2000 will provide this trigger by monitoring the status of its NLI and NCT links and sending the hardware status of these units to its RSMs with ISM nailups whenever a change occurs.

The HSM-2000 must also send its NLI and NCT link status to its child RSMs with ISM nailups on a periodic basis as a refresh mechanism. If communication between the HSM-2000 and its child RSM(s) does not exist at the time the hardware change occurs, the hardware status of the HSM-2000 must be sent after communication is reestablished.

11.3.2.2 Measurements

There are no requirements unique to HSM for traffic and plant measurements. The capability of HSM-2000 to scale to 30 subtending RSMs has no impact on measurements. All the OA&M requirements for SM-2000 shall apply to HSM-2000. The SM-2000 hardware fault detection mechanisms implemented in hardware and software such as parity generation/detection, CRC checks, per call testing, sanity checks, audits, etc, need to work for HSM-2000. The HSM-2000 must be able to detect at least 98% of all hardware faults while using automatic testing, in-service continuous testing, and demand diagnostic testing capability available to the SM-2000.

11.3.2.3 Initialization

All RSM(s) subtending from an HSM-2000 are capable of being fully initialized (without pump) without disrupting stable calls on the HSM-2000. If an RSM(s) subtending from an HSM-2000 is fully initialized with pump, calls in the HSM-2000 which occupy the pump time slots will be affected (i.e., torn down) if the time slot is borrowed for pump. Stable calls from the initing RSM(s), passing through the HSM-2000 will also be dropped. This is the current applicable scheme for pump an RSM subtending from a HSM.

HSM-2000 must be capable of full-initialization without disrupting transient or stable calls in its subtending RSM(s), with the following exceptions:

- Calls passing through the HSM-2000 will be torn down during HSM initialization.
- Subtending RSM(s) may go into stand-alone during HSM-2000 initialization. When HSM-2000 initialization occurs, the stand-alone interval of the subtending RSM(s) must not exceed the HSM-2000 initialization interval.

11.3.2.4 Performance Monitoring

Performance monitoring is the systematic monitoring (or tracking) of a particular entity's health through the continuous collection and analysis of data derived by observing the entity's performance.

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In order to provide end-to-end performance measurement of the umbilicals subtending RSM(s) from an HSM-2000, performance data must be collected and analyzed in order to detect performance degradation and provide a basis for network maintenance. For HSM-2000, performance monitoring refers to the set of actions needed to collect, store, threshold, and report end-to-end performance of the umbilicals between it and the subtending RSM(s).

11.4 RSM UMBILICAL ORDER WIRE

The order wire in the single-module RSM is used to provide an independent voice grade circuit between the RSM and the host *5ESS*® switch to extend the office beltline for teletypewriter (TTY) access from the remote site. With applications where the umbilical is routed by microwave radio, the TTY link can be treated the same as any other voice circuit multiplexed onto the carrier system as long as it remains independent of the RSM.

11.5 RSM UMBILICALS

Typically, T1 carrier facilities are used to connect the RSM to the host *5ESS*® switch. The link is traffic-sensitive and simulates the NCT links of a local SM, carrying both network (call) and control data. The two control time slots are dedicated to channels in two separate T1 lines with the capability of automatically switching to dedicated channels on separate backup lines should the primary lines fail. This arrangement requires a minimum of two T1 lines and is limited by the requirement that all umbilical facilities from an RSM must terminate on the same host module.

The interface between the T1 facilities and the time slot interchanger (TSI) of the RSM is the FIU. The FIU converts T1 carrier format to NCT link format and vice versa. A single FIU can accommodate the maximum of 20 T1 lines for the umbilical. The T1 lines terminate at the RSM through digital facilities interface (DFI) circuit packs mounted in digital line trunk units (DLTUs). This use of the DLTU does not use any of the RSM time slots or call capacity. Standard cross-connections through a repeater bay or digital cross-connect (DSX) frame are required.

A separate metallic facility is required to provide remote maintenance terminal access to the host AM from the RSM. The order wire provided with T1 facilities may be used. To improve reliability, route diversity of the T1 facilities is strongly recommended.

The engineering of T1 lines for the umbilical follows methods developed for the remote switching system voice channels. The once-a-month (OAM) usage is estimated for outgoing and incoming traffic (including traffic to and from the host) and 3-way calling (3-port conference usage, multiplied by three, to reflect the usage of each port). The blocking probability 0.0005 (blocking probability 0.001, high day) table is then used to determine the number of channels required. Added to this total are four channels for control and control backup. This total is then divided by 23 to determine the number of T1 lines required (one channel per T1 line is required for signaling). A minimum of two T1 lines must be provided. At the host, umbilical T1 lines are included in DLTU engineering.

A subtending RSM affects the host beyond the additional T1 line terminations as follows:

- Additional usage on the host universal conference circuits.
- Additional load on central and host SM processors. The additional CDO load on the host is mitigated to the extent that the host processes interoffice calls to/from the RSM prior to cutover. The administrative processor is used only for calls that leave the RSM.

11.5.1 MULTIMODULE RSM (MMRSM)

The MMRSM enables the installation of a larger RSM facility or the expansion of an existing single-module RSM. With this arrangement, two to four RSMs may be configured and interconnected to provide

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additional switching capacity at the RSM location. Each RSM of the MMRSM can provide the same switching capacity as a single-module RSM. A block diagram illustrating the configuration of the MMRSM is shown in Figure 11-5 and 11-6 .

Each RSM is connected to a host SM (HSM) at the *5ESS*® switch office via standard T1 carrier umbilicals (a minimum of two). More than one HSM may be used to provide the umbilical interfaces; however, all umbilicals from a given RSM must terminate on the same HSM. Additionally, each of the RSMs in the cluster is connected to each of the other RSMs by inter-RSM communication links (ICL). These links provide the ability to complete calls between the remote modules of the MMRSM without any services from the HSM. This is particularly important if standalone operation is required due to umbilical outages. The ICLs are provided by T1 facilities and the FIU in a manner similar to the umbilicals. A DFI circuit is required at both ends of the ICL to provide an interface with the FIU. The total number of umbilicals and ICLs per module in an MMRSM cannot exceed 20 and is engineered based on traffic requirements.

A minimum of two ICLs connect the RSMs in an MMRSM. No channels are dedicated for interprocessor message transmission on the ICLs, as there are on the umbilicals to the host; however, one channel on each ICL is dedicated to signaling. During normal operation, messages are passed between the modules in the MMRSM using control time slots on the umbilical T1 links to the host SM, and ultimately, to the communications module (CM).

Voice and data are carried between the RSMs in the MMRSM on the ICLs. A 4 Kbps data link is also provided on each ICL. This data link is used for inter-RSM message traffic when the control time slot is disrupted.

The MMRSM uses standard SM hardware as does the single-module RSM, and it can serve lines, trunks and *SLC*® 96 carrier facilities. The environmental requirements are the same as the *5ESS*® switch, and the connections to the host are via standard digital facilities. The MMRSM can be remoted up to 150 miles from the *5ESS*® switch office. This arrangement provides extensive options for area planning. Modernization needs and increased demands for service may be met through:

- Incremental growth of peripheral units (the addition of line units, trunk units, etc.)
- Adding or removing remote modules from existing RSMs
- Converting co-located single-module RSMs to MMRSMs
- Growing an RSM from a *5ESS*® switch base
- Homing a *SLC*® 96 carrier system on an RSM
- Adding or removing ICLs or umbilicals.

Further, a wide range of custom digital features and services are supported. These include:

- Complete *5ESS*® switch feature set during normal linked operation
- Full trunking capability
- An optional RSM status display
- Optional 13A announcement machines
- Optional standalone operation
- Optional automatic billing during standalone
- Optional high-stability remote clock unit (used when data applications may be served from the RSM

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during standalone)

- Limited custom calling services during standalone.

Any feature the host provides is also available in the RSM during linked-mode operation. Calls originating and terminating within the MMRSM can be routed without communicating with the administrative module (AM)/communication module (CM). The routing software first checks for the terminating port within the module in which the call originated. If not found, the other modules within the MMRSM are checked for the terminating port. Finally, the AM/CMP is requested to route the call if the terminating port is not within the MMRSM. Calls can also be routed by the AM/CMP through the CM in the event that an ICL talking path is unavailable (for example, during maintenance, out-of-service, or overflow).

Stand-alone call processing is an optional feature that allows the MMRSM to continue processing calls in a standalone mode.

The implementation of this arrangement also provides a greater level of reliability. Since more than one set of umbilicals are provided, and since the remote modules are interconnected via ICLs, it may still be possible to process certain calls in the event of umbilical or ICL outages. Three levels of standalone operation are provided to assure the best possible service. These levels are defined as follows:

- ***Partial Standalone***: Partial standalone exists when one or more, but not all, of the MMRSM remote modules cannot communicate with the respective HSMs (due to umbilical outage). In this case, intra-MMRSM calls originating or terminating to a remote module in standalone operation can be completed via the ICLs which interconnect all the remote modules. Limited custom calling services are still available in this instance. These services include call waiting, call hold, speed calling to lines terminating on the MMRSM, limited hunt group calls, and access to private facilities. This is possible because the necessary translations and routing data for most lines and trunks served by the MMRSM are duplicated in each of the remote modules. Calls requiring conference circuits cannot be completed in this instance because conference circuits are provided only at the HSM. Additionally, calls requiring AM/CMP routing (such as calls to global hunt groups which are routed by the AM/CMP and calls originating or terminating outside of the MMRSM) cannot be completed. However, calls of this type involving lines served from remote modules which are not operating in standalone can still be completed normally.

- ***Separation***: All modules in the MMRSM are co-located; therefore, repeaters are not required for the ICLs. Separation exists when all the ICLs between the originating and terminating remote modules of an MMRSM are severed, or if a call cannot be completed over the ICLs for any reason other than ICL overload. If an RSM is in separation, it does not go down, but rather attempts to complete calls to the separated RSM(s) through the host via the umbilicals (called back-hauling). This approach is also used when the ICLs are not severed but are completely busy. This call completion path is identical to the one that two single-module RSMs would use to communicate with each other. It is important that the ICLs are adequately engineered and administered so that back-hauling is not required.

- ***Total Standalone***: Total standalone exists when all umbilicals between the MMRSM and the *5ESS*® switch office are inoperable. In this case, all intra-MMRSM calls involving the limited custom calling features previously described (or involving no features) can be completed normally, except those that require conference circuits and those involving global hunt groups. During total standalone, calls originating outside the MMRSM and attempting to terminate on hunt groups on the MMRSM, and calls originating at the MMRSM and attempting to terminate outside the MMRSM cannot be completed. Calls between the modules of an MMRSM are completed, and emergency calls are given special treatment. Alternate routing of emergency calls is provided through the use of foreign exchange lines. Up to ten foreign exchange lines can be assigned; and if a specified number is dialed, the call is routed to another host outside the MMRSM where it can be handled appropriately. Additionally, carrier interconnect and many modular feature construction (MFC) features are functional during standalone.

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Stand-alone billing may be used whether the MMRSM is in total or partial standalone.

11.6 ENGINEERING CONSIDERATIONS

11.6.1 SM

The RSMs are limited by umbilical time slots. Two to 20 umbilical links may be provided between the DLTUs in the host SM and the DLTUs in the RSM. The T1 carrier facilities, which are usually used for RSM umbilicals, provide 24 channels per link. Each umbilical has either 2 or 4 control time slots and 1 signaling time slot. The remaining time slots are used to carry voice (customer calls). Table 11-1 provides umbilical time slot capacity information.

Table 11-1 RSM Umbilical Time Slot Capacities

UMBILICALS	TIME SLOTS				BLOCKING CRITERIA (CCS/HR)	
	VOICE	CONTROL	SIGNALING	TOTAL	P.0005 EVE	P.001 TCBH HD
2	44	2	2	48	914	947
3	67	2	3	72	1,588	1,603
4	88	4	4	96	2,173	2,226
5	111	4	5	120	2,865	2,926
6	134	4	6	144	3,569	3,638
7	157	4	7	168	4,285	4,360
8	180	4	8	192	5,008	5,089
9	203	4	9	216	5,737	5,825
10	226	4	10	240	6,504	6,599
11	249	4	11	264	7,212	7,312
12	272	4	12	288	7,955	8,062
13	295	4	13	312	8,703	8,814
14	318	4	14	336	9,453	9,561
15	341	4	15	360	10,206	10,306
16	364	4	16	384	10,961	11,052
17	387	4	17	408	11,719	11,797
18	410	4	18	432	12,479	12,542
19	433	4	19	456	13,240	13,287
20	456	4	20	480	13,954	14,032

Engineering of the MMRSM ICLs is based on the volume of traffic between each pair of RSMs within the MMRSM. Each ICL carries telephone traffic on 23 of its 24 channels. The remaining channel is used for signaling. (The ICLs require no control time slots.) A minimum of 2 ICLs are required between each pair of RSMs.)

A maximum of 20 T1 links can be provided per RSM within the MMRSM. This number includes the umbilicals back to the host SM as well as the ICLs to the remaining RSMs within the MMRSM. For example, an MMRSM with 4 RSMs could have 4 T1 umbilicals from each RSM to a host SM. Each RSM then has 16 T1 links remaining which can be used as ICLs to the other RSMs. If the minimum number of ICLs are equipped (2 to each of the other RSMs), a total of 10 of the 20 available links would be used. Table 11-2 provides ICL capacity information.

NOTE: The ISDN circuit-switched digital capability provides circuit-switched B-channel transport between ISDN terminals at a 56 kb/s or 64 kb/s clear channel data rate. The intra-switch data rate capability depends upon the data rate capability of the host-to-RSM transmission facilities. To provide 64 kb/s ISDN circuit switched data capability on an RSM, the umbilical to the RSM must support that data rate.

Table 11-2 RSM ICL Capacities

ICLs	TOTAL TIME SLOTS	SIGNALING TIME SLOTS	VOICE TIME SLOTS	BLOCKING CRITERIA (CCS/HR)	
				P.02 EVE	P.04TCBH HD
2	48	2	46	1,194	1,255
3	72	3	69	1,910	1,987
4	96	4	92	2,674	2,767
5	120	5	115	3,393	3,505
6	144	6	138	4,089	4,224

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7	168	7	161	4,785	4,943
8	192	8	184	5,481	5,226
9	216	9	207	6,177	6,381
10	240	10	230	6,873	7,101
11	264	11	253	7,569	7,820
12	288	12	276	8,265	8,539
13	312	13	299	8,961	9,258
14	336	14	322	9,657	9,977
15	360	15	345	10,353	10,696
16	384	16	368	11,049	11,415
17	408	17	391	11,745	12,134
18	432	18	414	12,441	12,853

11.7 ASSIGNMENT GUIDELINES

Since the RSM is an SM which is remoted from the *5ESS*® switch office, the assignment of RSM resources is no different than the assignment of SM resources. Those resources include:

- SM processor
- Memory
- Line units
- Digital carrier line units (DCLUs)
- DLTU (for RSM umbilicals, ICLs, and trunks from RSMs)
- Service circuits
- Recorded announcements.

For information concerning these resources, refer to the appropriate sections of this manual.

11.8 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

The RSM resources which are the same as SM resources have the same measurements as those taken in the SM. These measurements are found in the sections of this manual associated with those resources. However, there are some measurements which apply specifically to the RSM. These measurements are described here.

11.8.1 RSM MEASUREMENTS

Section 22 of the TRFC30 report provides measurements associated with the RSM. These measurements are discussed in 235-600-750 *Output Messages Manual*.

11.8.2 UMBILICAL TIME-SLOT MEASUREMENTS

Umbilical time slot measurements are found in Section 23 of the TRFC30 report and are discussed in 235-600-750 *Output Messages Manual* . These measurements are taken for each RSM and are associated with the RSM umbilical time slots.

11.8.3 MMRSM MEASUREMENTS

Measurements related to ICLs are found in section 37 of the TRFC30 report and are described in 235-600-750 *Output Messages Manual* . These measurements are made for each ICL.

Section 39 of the TRFC30 report provides standalone usage measurements. These measurements are made on a per-site basis.

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11.9 FEATURE IMPACT

The impact of features on an RSM is the same as for an SM. The resources required to support features are the same as those provided in the SM and are discussed in the associated section of this manual. Additionally, 235-190-103 - *Business and Residence Modular Features* provides further information concerning the various features available and the impact on the switch resources.

11.10 TRANSITION IMPACT

Transitions involving the RSM are similar to those involving the SM. There are several types of growth operations which apply directly to RSMs. These may include:

- Growth of an RSM to an MMRSM
- Growth of an RSM or MMRSM to a *5ESS*® switch office
- Degrowth of an MMRSM to an RSM
- Degrowth of a *5ESS*® switch office to an MMRSM or RSM
- Growth of ICLs and umbilicals.

These procedures are installation, cutover, and turnover procedures that do not require administrative functions. Refer to the following documents for complete descriptions of growth procedures:

- 235-118-XXX - *Recent Change Procedures*
- 235-600-31X - *Equipment Configuration Data*.

11.11 REMOTE SWITCHING MODULE WORKSHEET

The worksheet (Figure 11-7) provides:

- RSM umbilicals MS (main station) capacity: Today and EOP (end of engineering period)
- Percent utilization of umbilicals: Today and EOP.

NOTE: The RSM umbilical is based on the number of main stations working in the RSM today, and the CCS (hundred call second) load generated by these main stations. Changes in the RSM calling rate (due to new toll billing, community of interest, area transfer, etc.) could affect the CCS load on the RSM umbilicals, thus changing the number of umbilicals.

- Three-port and 6-port conference circuits are provided at the host office. A push to sell more conference features could affect the number of umbilicals needed.
- Announcements are provided from the host. Announcement requirements could affect the number of RSM umbilicals needed.

The following paragraphs identify the columns of the RSM Umbilicals worksheet and describe the calculations required to complete the worksheet:

(A) RSM Number: The number of the RSM module that this row on the worksheet represents.

(B) HSM Number: The number of the HSM (host switching module) on which this RSM terminates.

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(C) RSM Umbilicals Channels Working: The number of umbilical channels working to this RSM. These channels are engineered in blocks of 23, except for the first two or four umbilicals which are engineered with 22 channels. Obtain this information from the switch or the telephone equipment order (TEO).

(D) Engineered Blocking Criteria: The criteria used to engineer this component. Valid entries include the following blocking percentages: 0.05, 0.1, 0.5, 1.0, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

(E) Umbilical CCS Capacity: The CCS capacity of the installed umbilicals for this RSM. Obtain number of working umbilicals from the appropriate Poisson table for the CCS capacity.

(F) CCS Usage Today - Main Station Demand: The number of main stations working on the RSM today. Obtain information from the switch or a current main station report.

(G) CCS Usage Today - CCS Demand: The current CCS usage on the RSM umbilicals. Obtain data from the current office engineering data.

(H) CCS Usage Today - CCS per Main Station: The umbilical CCS load per RSM main station. Obtain number from the current office engineering data or calculate:

CCS Usage Today CCS Demand *Column G* _____ CCS Usage Today RSM MS Demand *Column F*	=	CCS Usage - Today CCS/MS *Column H*

(I) ***CCS Usage EOP - Main Station Demand:*** The total number of main stations forecasted for EOP. Obtain this information from the office forecast.

(J) ***CCS Usage EOP - CCS per Main Station:*** The umbilical CCS load per RSM main station forecasted for EOP. Obtain this information from the office forecast.

(K) ***CCS Usage EOP - CCS Demand:*** The forecasted CCS usage on the RSM umbilicals. To calculate:

CCS Usage - EOP MS Demand *Column I*	□	CCS Usage - EOP CCS/MS *Column J*	=	CCS Usage - EOP CCS Demand *Column K*

(L) ***Main Station Capacity of Umbilicals - Today:*** The main station capacity of the RSM umbilicals today. To calculate:

Umbilical CCS Capacity *Column E* _____ CCS Usage/MS - Today *Column H*	=	Main Station Capacity or Umbilicals - Today *Column L*

(M) ***Main Station Capacity of Umbilicals - EOP:*** The forecasted main station capacity of the RSM umbilicals. To calculate:

Umbilical CCS Capacity *Column H* _____ CCS Usage/MS - EOP *Column J*	=	Main Station Capacity of Umbilicals - EOP *Column M*

(N) ***Umbilical CCS Load Percent Utilization - Today:*** The percent of the RSM umbilical channels that are being used today. To calculate:

CCS Usage - Today CCS Demand *Column G*	Umbilical CCS Load Percent Utilization

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Today *Column N* _____ Umbilical CCS Capacity *Column E*	□ 100 =	

(O) ***Umbilical CCS Load Percent Utilization - EOP:*** The percent of the RSM umbilical channels that will be used at the end of the engineering period.

CCS Usage - EOP CCS Demand *Column K* _____ Umbilical CCS Capacity *Column E*	□ 100 =	Umbilical CCS Load Percent Utilization - EOP *Column O*

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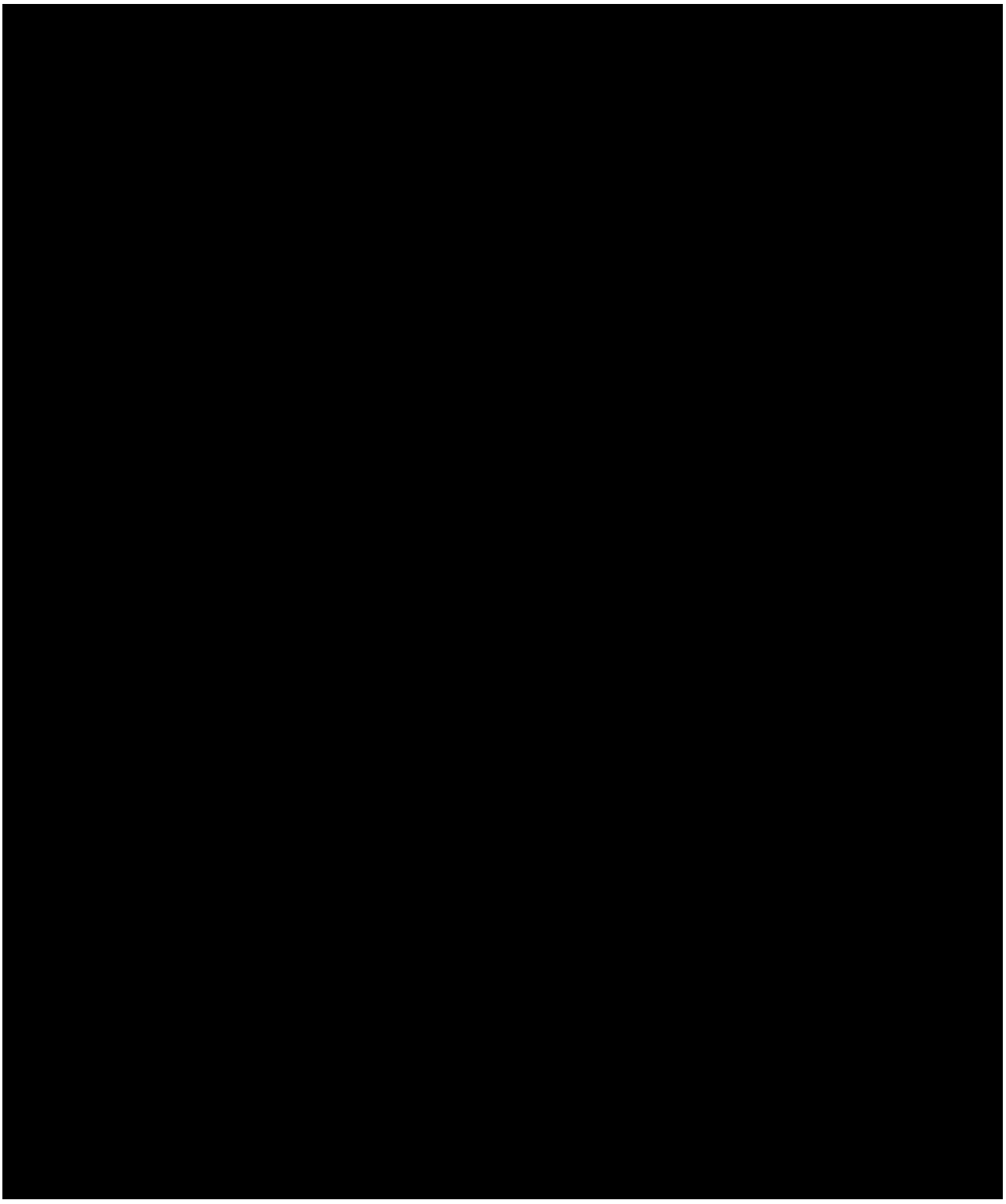

Figure 11-1 Simplified Block Diagram of RSM to 5ESS Switch Office Interconnections

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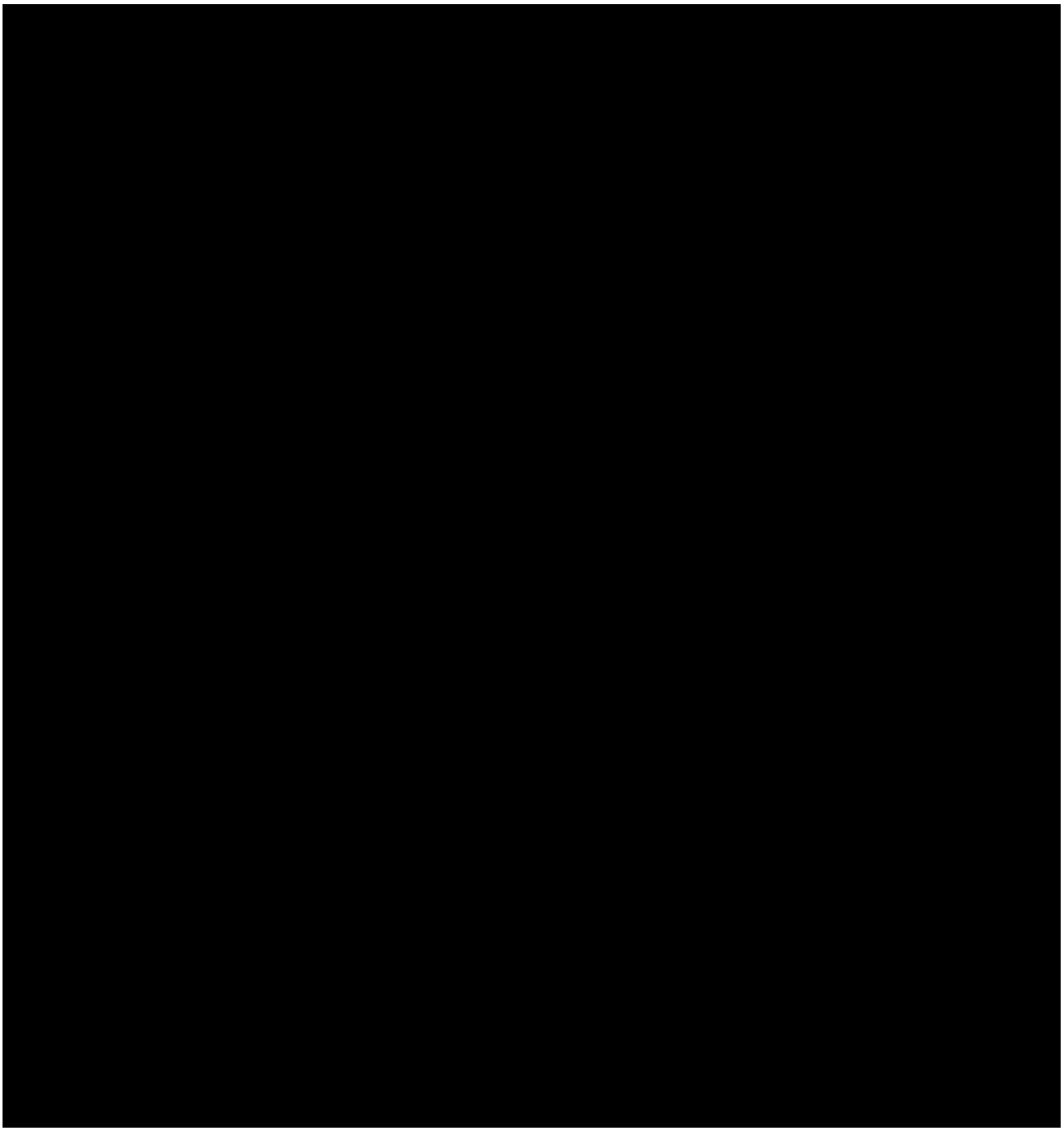

Figure 11-2 Optically Remoted Module Using Transmission Rate Converters

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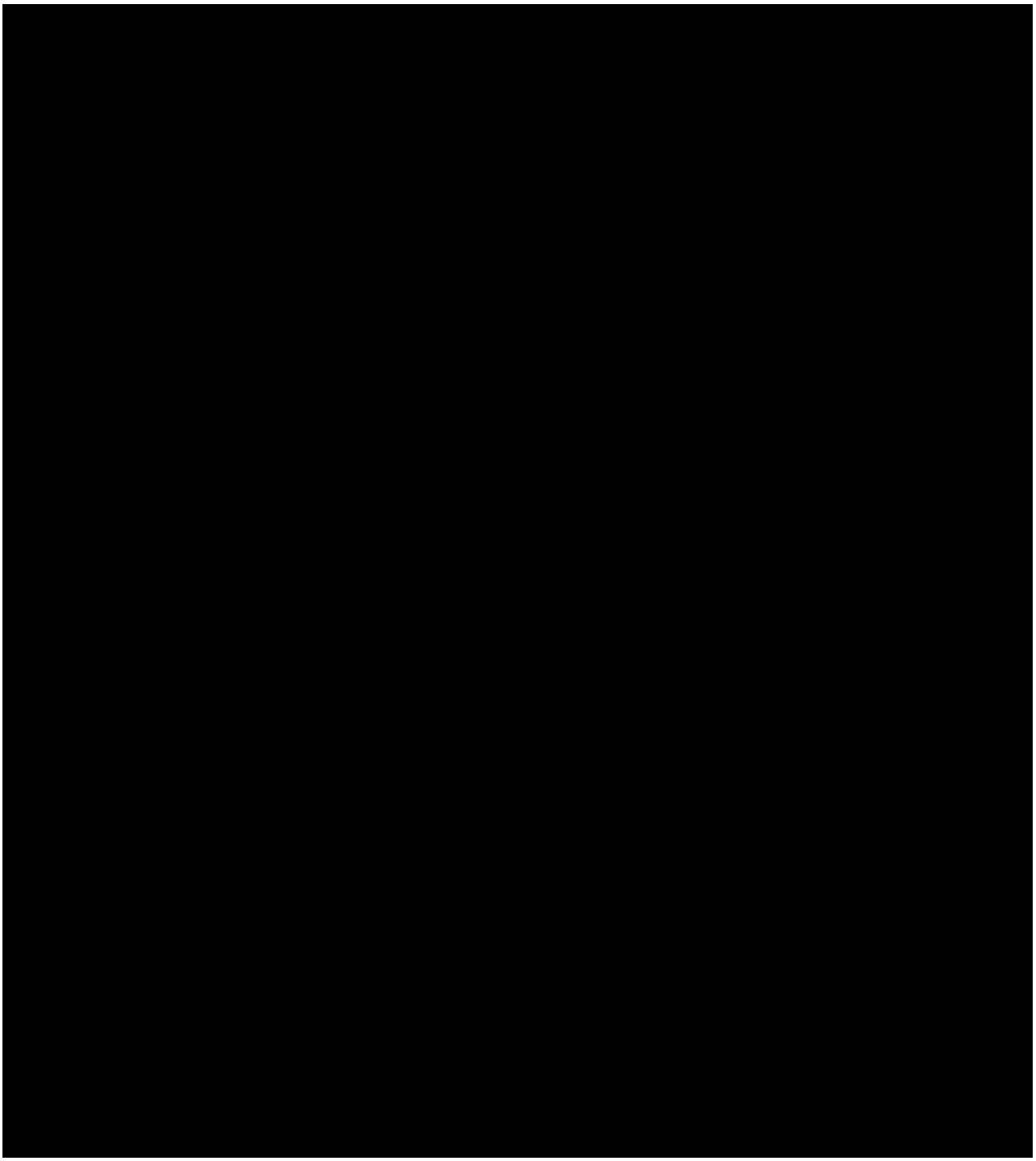

Figure 11-3 2-Mile Optically Remoted Module

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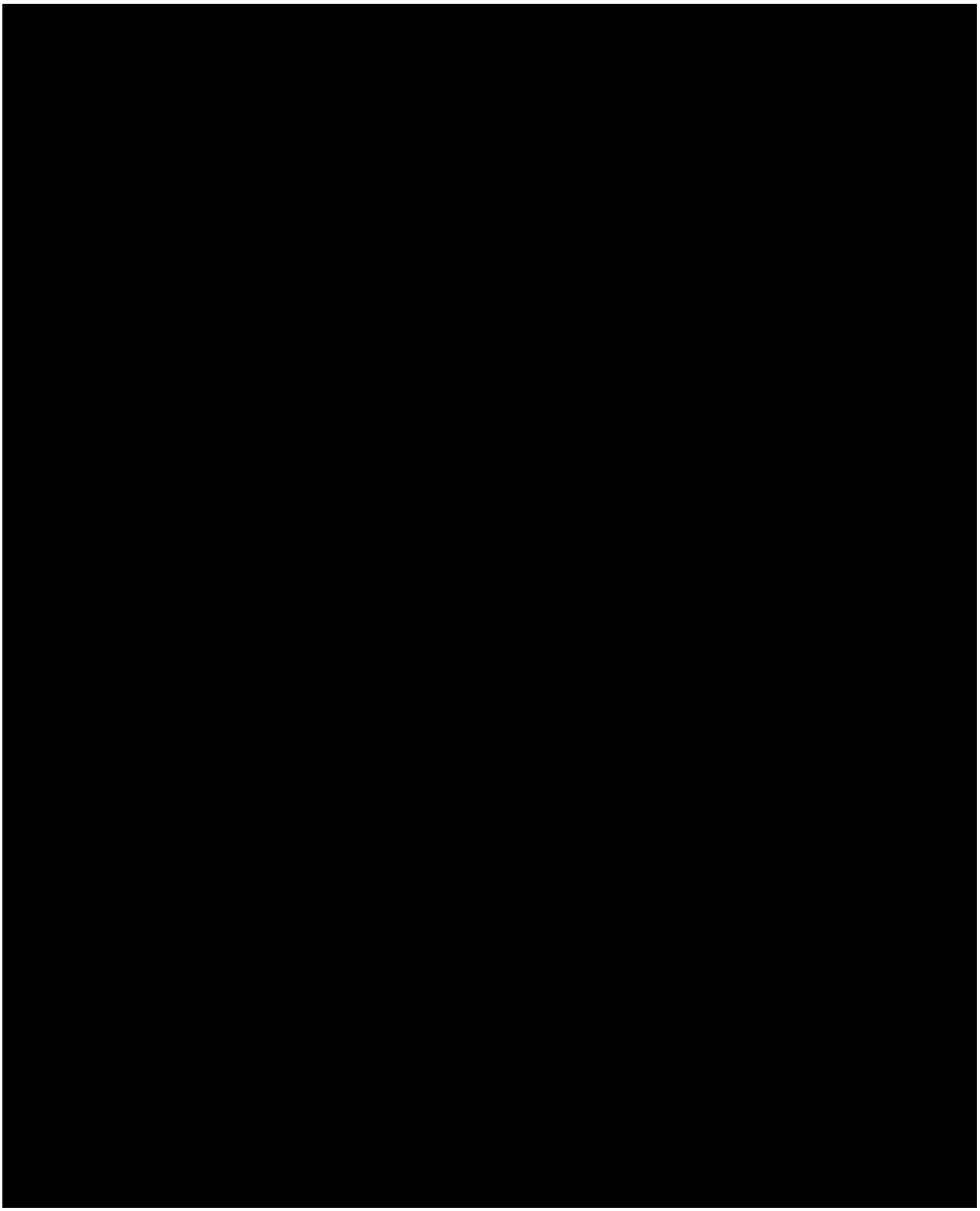

Figure 11-4 Optically Remoted Modules Using Transmission Rate Converter - Model 2 (TRCU2)

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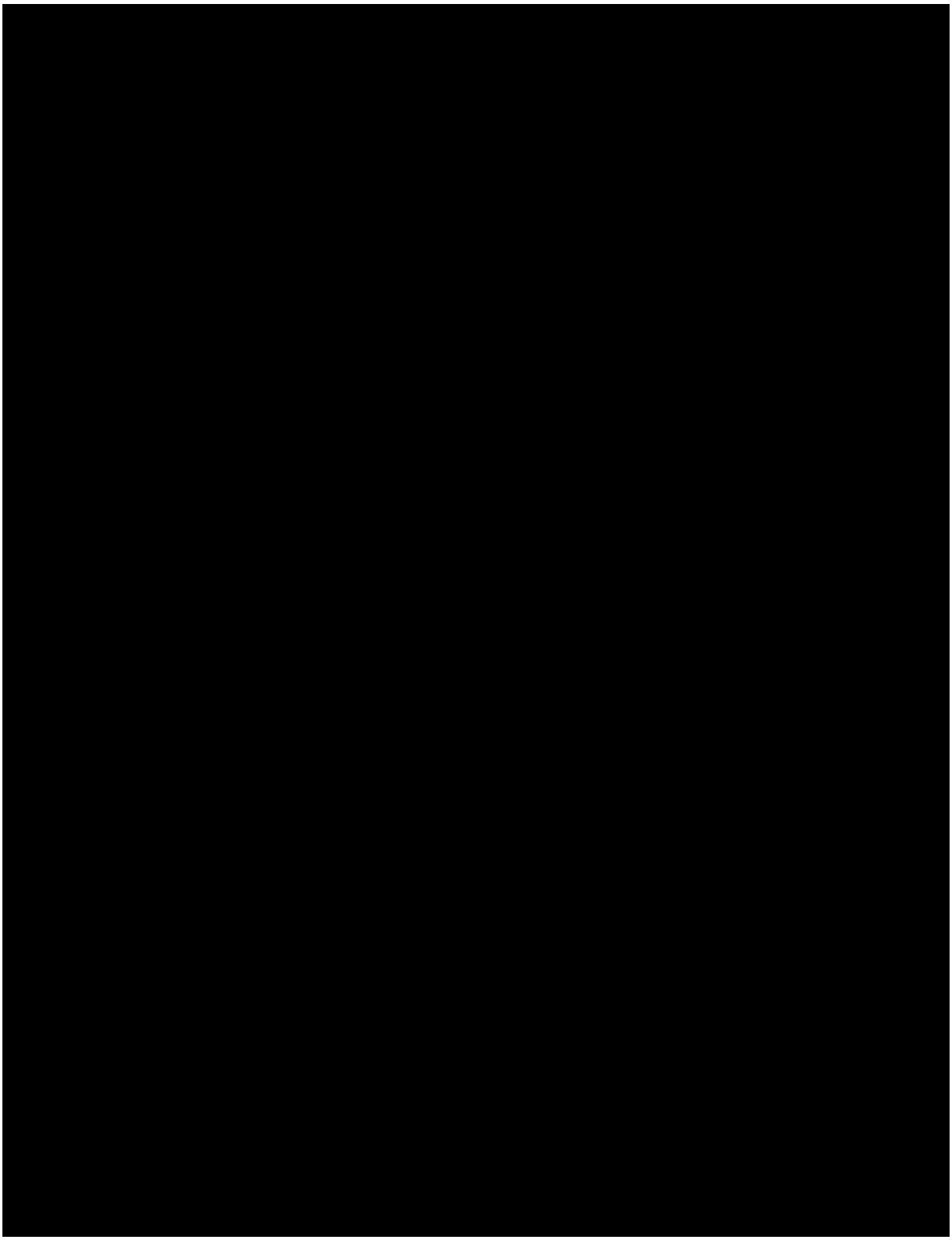

Figure 11-5 MMRSM Configuration (Served From One SM)

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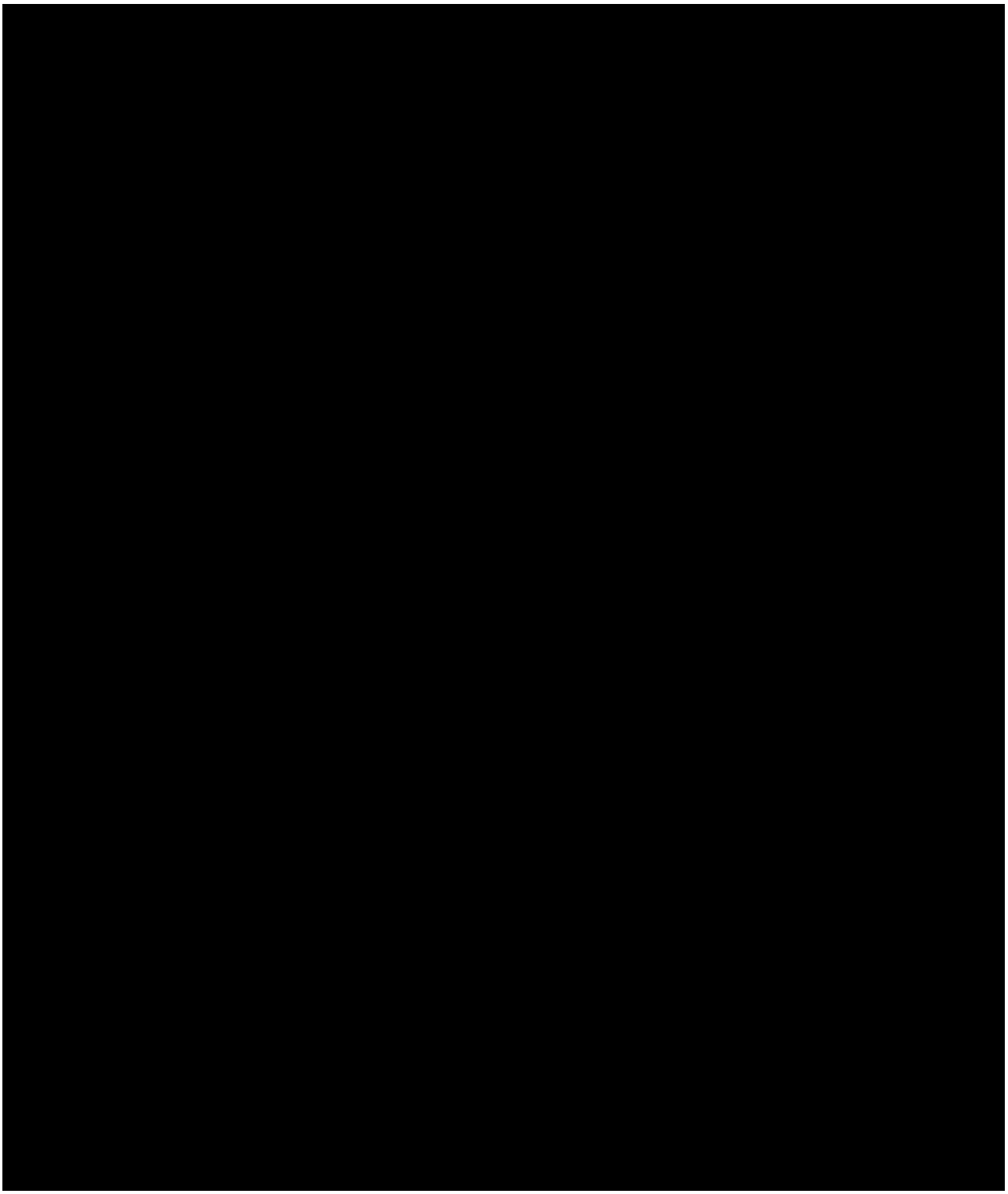

Figure 11-6 MMRSM Configuration (Served From Two SMs)

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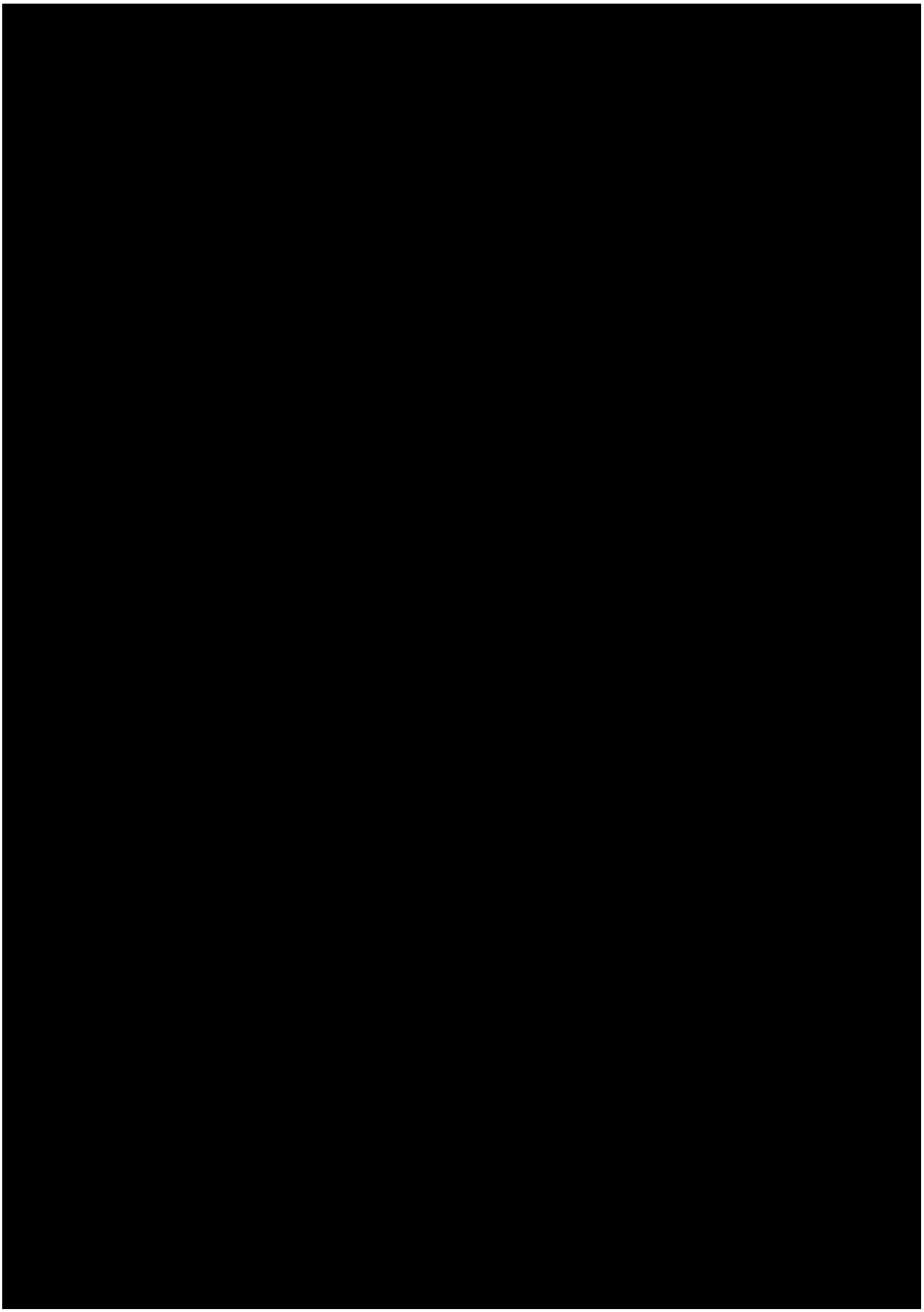

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Figure 11-7 Remote Switching Module Umbilicals Worksheet

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12. SM-2000 UNIQUE RESOURCE UTILIZATION

12.1 INTRODUCTION

The SM-2000 is a new offering on the *5ESS*® switch. The SM-2000 offers the capability to terminate Synchronous Optical Network (SONET) interfaces via the Digital Networking Unit - SONET (DNU-S), analog lines via the Line Unit Model 3 (LU3) or AIU/EAIU and digital trunks via the Digital Line and Trunk Unit Model 2 (DLTU-2). The SM-2000 also supports a Digital Service Unit - Model 3 (DSU-3) which provides tone decoder and tone generation capabilities to the SM-2000 via Digital Service Circuit Model 3 (DSC-3) units, ISLU, PSU, AIU/EAIU and IDCU for ISDN capability.

The SM-2000 offers users the capability to engineer up to 30,720 time slots on a single SM-2000, compared to 512 peripheral plus 512 network time slots on SMs. The engineering capacity of the SM-2000 is now determined by the available number of Peripheral Interface Data Busses (PIDBs), Peripheral Interface Control Busses (PICBs), time slots, or by the total available SM-2000 real-time, and not on the fixed 512 time slot capacity of the SM.

On an SM-2000, a feature has been developed called "peripheral-to-peripheral." A line/trunk call to another line/trunk does not involve the network unless the call leaves the SM-2000. Engineers can configure the SM-2000 Time Slot Interchange (TSI) in a square or non-square configuration. Engineering the SM-2000 TSI with the square concept provides an equal number of peripheral and network side traffic bearing time slots. A non-square TSI provides more peripheral than network time slots. For example, if there is only one SM-2000 in the office and one conventional SM, there is no need to provide more than 512 network time slots.

The SM-2000 cannot be deployed as an Remote Switching Module-2000 (RSM), but may be used as a Host SM-2000 terminating umbilicals from an RSM. The SM-2000 can, however, be remoted via the EXM-2000 (Extended SM-2000) feature. The EXM-2000 provides the capability to deliver SM-2000 functionality at a remote location.

The SM-2000 can be grown into an existing *5ESS*® switch or provided with a new *5ESS*® switch. Both the SM-2000 and the EXM-2000 utilize a microprocessor complex, a Message Handler, a growable Time Slot Interchange Unit Model 4 (TSIU4) as its core, and new network and peripheral interfaces.

At present, the quantity of equipment needed for a CM2 is determined by the number of SMs in the office (each SM carries a fixed number of Network Time Slots). With the introduction of SM-2000 and EXM-2000, the number of Network Time Slots per SM-2000 and EXM-2000 are no longer fixed. A new set of engineering and ordering rules for CM2 offices with SM-2000 (using NCT2 links) and/or SMs/EXM-2000 (using NCT2 links) is used.

12.2 SM-2000 PROCESSOR

For an overview of the Switching Module-2000 (SM-2000) processor, refer to the discussion of the SM processor in the SM RESOURCE UTILIZATION

12.2.1 Real Time Call Detail Real Time Usage

> **WARNING:** Any SM-2000 that is designated as a global billing SM must be engineered at only 75% of real-time capacity. It is necessary to reserve 25% of SM capacity for billing record activity. Failure to do this will result in an overload condition during peak hours and loss of billing records.

12.3 SM-2000 REAL TIME WORKSHEETS

The SM-2000 Real-Time Worksheet estimates the switching module (SM-2000) "real-time" call capacity either in half calls per busy hour or in full calls per busy hour at 90 percent occupancy, and the SM-2000 processor (SMP) occupancy at the offered load. Worksheets are found in the section of this document

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entitled "SM Resource Utilization". The worksheet enables switch administrators to make an appropriate assignment of lines, trunks, attendants, and features to SM-2000s, considering the associated real-time use of the SMP. The term "SM-2000" used in this worksheet refers to an SM-2000 or Extended Switch Module 2000 (EXM-2000). As a general guideline, this worksheet is needed only when one of the following is true:

(1) The following formula produces a result greater than 90,000:

sum

{(Number of analog nonshared DN centrex lines),
2 □ (Number of analog shared DN centrex lines),
80 □ (Number of analog attendant consoles),

multiplied by

(Average high day busy hour O + T calls/line)

plus

[Average high day (Incoming + Outgoing) calls/trunk]

multiplied by

\(*m (Number of digital attend consoles) 0.7 □ (Number of trunks)

(2) An Intelligent Processor [as an Automated Response Unit or Service Circuit Node, causes call transfers to occur, and has more than 100 connected lines.

12.3.1 Using the Worksheet

The SM-2000 real-time worksheet provides spaces to enter the input data and the results of the arithmetic calculations. In many cases, a "skeleton equation" is provided below the basic line in the worksheets for your convenience in making intermediate calculations to determine " ***YOUR INPUT***."

The means for determining the data inputs may vary. As an example, input data for ***CALL WAITING*** can be determined as follows:

- Data can be collected for all terminal groups in the SM-2000.
- Data can be collected on a selected subset of terminal groups and the results extrapolated to represent the office totals.

Nominal or "common-sense" values may be used to supplant the need for a detailed analysis in many instances, particularly where low feature-penetration exists in the office.

Also, note that the ***MSEC PER CALL*** coefficient is a measure of the relative importance of the various inputs. For example, ***SPEED CALLING, 1 Digit*** is much less significant than ***CALL TRANSFER***.

"5ESS" SWITCH

SWITCH MODULE REAL-TIME WORKSHEET

The minimum overhead occupancy of the SMP60 is 4% of the

Switching Module Processor's time. Additional overhead occupancy

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is incurred from the LUs in the SM-2000 , and depends on the number

of line units and their concentration ratios. No additional overhead

is incurred by ISLUs or (E/X)AIUs on the SM.

Please input the expected traffic partition & feature

penetration during

a 1-hour interval. The general format of this worksheet is:

SM-2000 TRAFFIC PARTITION	NUMBER (NO. OF CALLS/HOUR)	CORE60 OVERHEAD PER UNIT OF UNITS	CORE60 OCCUPANCY OVERHEAD OCCUPANCY (PERCENT)	(PERCENT)
_____	_____	x _____	= _____	|

_____|

1. NUMBER OF 4:1 LINE UNITS x 0.15 =

ON THIS SM. _____ _____ _____

2. NUMBER OF 6:1 LINE UNITS x 0.19 =

ON THIS SM. _____ _____ _____

3. NUMBER OF 8:1 LINE UNITS x 0.24 =

ON THIS SM. _____ _____ _____

4. NUMBER OF 10:1 LINE UNITS x 0.28 =

ON THIS SM. _____ _____ _____

5. NO MMRSM CONFIGURATION x 0.22 =

ON SM-2000. _____ _____ _____

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_____

Sum of the above 4 calculations (items 1 through 4) ==>|A: |
|_____|

Expected no-load occupancy (A + 4) ==>|B: |
|_____|

_____

TRAFFIC PARTITION

(ORIGINATING AND TERMINATING CALL MIX)

Please input traffic partition during your high day busy hour (number of (O+T) calls per hour). The number of originating and terminating calls per partition can be estimated as follows:

average high-day busy hour calling rate of O+T calls per end-user

x number of end-users

or

average high dy busy CCS per end-user

_____ x number of end-users

average holding time in seconds per call

Where the "end-user" is defined as:

1. Customer premises equipment (CPE) such as an analog phone,

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shared or nonshared directory number (DN) of a digital phone, terminal, attendant console, printer, computer, FAX machine, applications processor (AP), etc.

2. Another switch (local, tandem, toll, PBX, etc.)

3. Conference circuit

4. Announcement circuit.

ANALOG LINES

TRAFFIC PARTITION

The general format of this worksheet is:

	CORE60 REAL-TIME PER UNIT (MSEC)	**CORE60 REAL-TIME CONSUMPTION (MSEC)**
NUMBER OF CALLS		
_____	x _____	= _____

If your SM-2000 has analog traffic, at least some of items 5 through 11 should be used. Each analog line should be classified in only one category.

6. NUMBER OF CALLS WHICH USE x 15 =

POTS LINES _____ _____ _____

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Number of calls per hour which originate from or terminate on POTS lines in this SM-2000. No features are assigned to these lines.

7. NUMBER OF CALLS WHICH USE x 18 =

RURAL OR SUBURBAN ANALOG _____ _____ _____

LINES

Number of calls per hour which originate from or terminate on rural or suburban analog lines, that is, analog lines with at least one of the following features assigned: speed calling, call forwarding, call waiting, or 3-way calling, LASS, and LTSB. If lines have features in addition to any of the ones mentioned here, it should not be included in this classification.

8. NUMBER OF CALLS WHICH USE x 22 =

NONATTENDANT NON-ETN _____ _____ _____

(NONELECTRONIC TANDEM NETWORK)

ANALOG CENTREX LINES

Number of calls per hour which originate from or terminate on nonattendant, non-ETN, analog centrex lines, that is, analog lines with at least one of the following features assigned: call pickup, individualized dialing plan (IDP), call transfer, automatic route selection (ARS), private facility access (PFA), terminal groups, modular queuing for lines, intercom call

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restriction (ICR), carrier interconnect (CI), or multiline hunt group (MLHG). These lines may also have been assigned features as listed in item 6, but they cannot have other types of features assigned. In particular, this item does not include shared DN lines included in item 9a,b,c.

9. NUMBER OF CALLS WHICH USE x 25 =

NONATTENDANT ETN ANALOG _____ _____ _____

CENTREX LINES

Number of calls per hour which originate from or terminate on nonattendant ETN analog centrex lines; that is, analog lines with at least one of the following features assigned: ETN trunk queuing, deluxe ARS, authorization and account code, message detailed recording (MDR), or simulated facilities group (SFG) calls. These lines may also have been assigned features as listed in items 7 and 8. This item does not include shared DN lines included in item 10a,b,c.

10a. NUMBER OF NON-ATTENDANT, NON ETN x 44 =

SHARED DN ANALOG CENTREX _____ _____ _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 2 to 4 members.)

10b. NUMBER OF NON-ATTENDANT, NON ETN x 65 =

SHARED DN ANALOG CENTREX_____ _____ _____

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Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 5 to 8 members.)

10c. NUMBER OF NON-ATTENDANT, NON ETN SHARED DN ANALOG CENTREX x 86 = _____ _____ _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 9 to 32 members.)

11a. NUMBER OF NON-ATTENDANT, ETN SHARED DN ANALOG CENTREX x 46 = _____ _____ _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 2 to 4 members.)

11b. NUMBER OF NON-ATTENDANT, ETN SHARED DN ANALOG CENTREX x 68 = _____ _____ _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 5 to 8 members.)

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11c. NUMBER OF NON-ATTENDANT, ETN x 89 =

SHARED DN ANALOG CENTREX _____ _____ _____

Number of calls originated from, or terminated to, a shared DN of non-attendant non-ETN analog centrex lines. (From 9 to 32 members.)

12. NUMBER OF CALLS WHICH USE x 57 =

ANALOG ATTENDANT _____ _____ _____

Number of attendant or centralized attendant calls per hour.

This item is for SM-2000 with any analog attendant console.

NON-ISDN TRUNKS

Note: Each trunk should be classified in only one of the categories (items 12 through 15).

13. NUMBER OF CALLS WHICH USE x 11 =

SS7 POTS TRUNKS _____ _____ _____

Number of incoming and outgoing calls per hour on POTS SS7 trunks that originate from or terminate on this SM-2000s.

14. NUMBER OF CALLS WHICH USE x 17 =

TRUNK CENTREX _____ _____ _____

Number of incoming and outgoing calls per hour on trunks which

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have at least one of the following features assigned: Uniform Numbering Plan, Overlap Outpulsing, or Cut-Through calls.

15. NUMBER OF CALLS WHICH USE x (21+2.4xNDS0) =

FRACTIONAL DS1 TRUNKS _____ _____ _____

Number of incoming and outgoing calls per hour on DS1 trunks on this SM-2000. "NDS0" is the average number of DS0 channels involved in the fractional DS1 trunk calls.

ISDN TRUNKS AND PRI

16. NUMBER OF CALLS WHICH USE x 4 =

TRUNK PACKET SWITCH DATA _____ _____ _____

Number of calls per hour over the incoming internal protocol (IP) trunk. This item is applicable if this SM-2000 is equipped with incoming IP trunks.

This item is applicable if this SM-2000 is equipped with incoming internal protocol (IP) trunks.

17. NUMBER OF CALLS WHICH USE x 16 =

PRIMARY RATE INTERFACES (PRI)_____ _____ _____

PLAIN OLD DIGITAL SERVICE (PODS)

Number of voice-only calls per hour originating from or terminating on featureless primary rate interfaces (PRI) which

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go to PBXs. This item is applicable if this SM-2000 is connected to PBXs by PRIs.

18. NUMBER OF CALLS WHICH USE x 21 =

PRI CENTREX _____ _____ _____

Number of voice-only calls per hour originating from or terminating on PRIs having INWATS or OUTWATS features going to a PBX. This item is applicable if this SM-2000 is connected to PBXs by PRI.

19. NUMBER OF CALLS WHICH USEx (38+2.4xNDS0) =

FRACTIONAL DS1 PRI _____ _____ _____

Number of incoming and outgoing calls per hour on DS1 PRIs on this SM-2000, multiplied by the average number of DS0 channels involved in the fractional DS1 trunk calls.

APPLICATION PROCESSOR

Items 20 through 24 are applicable only if an AP is attached via BRI/DSLs to the SM-2000. The real time for these items as indicated in the "SM-2000 REAL-TIME CONTRIBUTION" column is the SMP real time spent in processing messages between the AP and the SMP. The SMP real time spent on processing messages between the user's ISDN CPE and the SMP can be found in items 36 and 37.

20. NUMBER OF CALLS WHICH USE x 2 =

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AP MESSAGE DETAILED RECORDING (MDR) _____ _____ _____

Number of MDRs per hour that are generated by the switch and sent to the SM-2000 AP.

21. NUMBER OF CALLS WHICH USE AP MESSAGE SERVICE SYSTEM (MSS) OR ELECTRONIC DIRECTORY SERVICE (EDS) x 5 = _____ _____ _____

Number of times per hour that an MSS or EDS system on the SM-2000 AP is initiated by the switch analog user.

22. NUMBER OF CALLS WHICH USE AP MSS OR EDS x 11 = _____ _____ _____

Number of times per hour that an MSS or an EDS session on the SM-2000 AP is initiated by the switch ISDN users. This item is applicable if up to 40 percent of the AP MSS or EDS ISDN users have the 40-character display feature.

23. NUMBER OF CALLS WHICH USE AP MSS OR EDS x 12 = _____ _____ _____

Number of times per hour that an MSS or an EDS session on the SM-2000 AP is initiated by the switch ISDN users. This item is applicable if 41 to 60 percent of the AP MSS/EDS ISDN users have

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the 40-character display feature.

24. NUMBER OF CALLS WHICH USE x 15 =

AP MSS OR EDS _____ ____ _____

Number of times per hour that an MSS or an EDS session on the SM-2000 AP is initiated by the switch ISDN users. This item is applicable if more than 60 percent of the AP MSS or EDS ISDN users have the 40-character display feature.

INTELLIGENT PROCESSOR

One example of an Intelligent Processor is a Service Circuit Node (SCN, an AIN implementation) linked to the SM-2000 via trunks. Another example is an Automated Response Unit (ARU) which is connected to the SM by an analog line.

25. NUMBER OF CALLS WHICH USE x 53 =

INTELLIGENT PROCESSOR _____ _____ _____

INITIATED TRANSFER

Number of calls terminating to a peripheral intelligent processor, with the intelligent processor then causing a call transfer to occur. The real times include only the intelligent processor termination and call transfer components and not any consumption by other features which may be involved in the call. The total effect on the SM-2000 real time consumption depends on how each vendor implements the feature on the intelligent processor.

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CONFERENCE AND ANNOUNCEMENT CIRCUITS

26. NUMBER OF CALLS WHICH USE x 9 =

CONFERENCE CIRCUITS_____ _____ _____

Number of times per hour that conference circuits are used.

This item is applicable if conference circuits are on the

SM-2000.

27. NUMBER OF CALLS WHICH USE x 11 =

ANNOUNCEMENT CIRCUITS _____ _____ _____

Number of times per hour that announcement circuits are used.

ISDN LINES

If the SM-2000 has ISDN traffic, at least some of items 28

through 42 should be used. One BRI/DSL can belong to more than one

category.

28. NUMBER OF CALLS WHICH USE x 22 =

PLAIN OLD DIGITAL _____ _____ _____

SERVICE (PODS)

Number of calls per hour which originate from or terminate on

featureless BRI/DSLs on the SM-2000.

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29. NUMBER OF CALLS WHICH USE x 30 =

NONATTENDANT NON-ETN _____ _____ _____

NONSHARED DN DIGITAL CENTREX

Number of calls per hour which originate from or terminate on a nonattendant, non-ETN, centrex, nonshared DN of a BRI/DSL. A nonattendant, non-ETN, centrex, nonshared DN is a nonshared DN with at least one of the following features assigned on the DN or BRI/DSL (and no other features assigned) speed calling, call forwarding, 3-way calling, call waiting, call pickup, call transfer, IDP, ARS, PFA, terminal group, modular queuing for lines, ICR, CI, MLHG, LASS, and ASP.

30. NUMBER OF CALLS WHICH USE x 32 =

NONATTENDANT ETN _____ _____ _____

NONSHARED DN DIGITAL CENTREX

Number of calls per hour which originate from or terminate on a nonattendant, ETN, centrex, nonshared DN of a BRI/DSL. A nonattendant, ETN, centrex, nonshared DN has at least one of the following features assigned to the DN or the BRI/DSL: queuing for trunks, deluxe ARS, authorization codes, account codes, and SFG. Features listed in item 29 may also be assigned to the DN or the BRI/DSL.

31a. NUMBER OF NON-ATTENDANT, NON ETN x 43 =

SHARED DN DIGITAL CENTREX_____ _____ _____

(SMALL GROUP)

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Number of calls originated from, or terminated to, a shared DN of a BRI/DSL or a multipoint BRI/DSL. (From 2 to 4 members.)

31b. NUMBER OF NON-ATTENDANT, NON ETN x 65 =

SHARED DN DIGITAL CENTREX _____ _____ _____

(MEDIUM GROUP)

Number of calls originated from, or terminated to, a shared DN of a BRI/DSL or a multipoint BRI/DSL. (From 5 to 8 members.)

31c. NUMBER OF NON-ATTENDANT, NON ETN x 86 =

SHARED DN DIGITAL CENTREX_____ _____ _____

(LARGE GROUP)

Number of calls originated from, or terminated to, a shared DN of a BRI/DSL or a multipoint BRI/DSL. (From 9 to 32 members.)

Note: With respect to items 32a, 32b, and 32c, a non-attendant, ETN centrex shared DN is a shared DN with at least one of the features listed in item 30 assigned on the DN or the BRI/DSL or the multipoint BRI/DSL. Features listed in item 29 may also be assigned on the DN or the BRI/DSL.

32a. NUMBER OF NON-ATTENDANT, ETN x 46 =

SHARED DN DIGITAL CENTREX _____ _____ _____

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(SMALL GROUP)

Number of calls originated from, or terminated to, a shared DN of a BRI/DSL or a multipoint BRI/DSL. (From 2 to 4 members.)

32b. NUMBER OF NON-ATTENDANT, ETN x 68 =

SHARED DN DIGITAL CENTREX _____ _____ _____

(MEDIUM GROUP)

Number of calls originated from, or terminated to, a shared DN of a BRI/DSL or a multipoint BRI/DSL. (From 5 to 8 members.)

32c. NUMBER OF NON-ATTENDANT, ETN x 89 =

SHARED DN DIGITAL CENTREX _____ _____ _____

(LARGE GROUP)

Number of calls originated from, or terminated to, a shared DN of a BRI/DSL or a multipoint BRI/DSL. (From 9 to 32 members.)

33. NUMBER OF CALLS FROM x 5 =

PACKET SWITCH DATA _____ _____ _____

ORIGINATIONS

Number of packet switch data calls per hour (including on-demand B-channel packet switch data calls) originating from, but not terminated to, the SM-2000.

34. NUMBER OF CALLS WHICH USE x 24 =

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CIRCUIT SWITCH DATA _____ _____ _____

Number of featureless circuit-switched data calls per hour originating from or terminating at the SM-2000.

35. NUMBER OF CIRCUIT-SWITCHED DATA x 28 =

CENTREX CALLS _____ _____ _____

Number of times per hour that circuit switched data calls originated from or terminated to this SM-2000 with at least one of the following features assigned: hunt group/transfer, MLHG queuing, ARS, PFA, authorization code, account code, ICLID, or MDR.

APPLICATION PROCESSOR

Items 36 and 37 are applicable only if the AP is attached to the switch by BRI/DSLs. (The AP may be attached to any SM-2000 on the switch.) The real-time consumption for these items is the SMP real time spent on processing messages between the user's ISDN CPE and the SMP. If the AP is connected to the SM-2000, the SMP real time spent on processing messages between the AP and the AP associated system process can be found in items 20 through 24.

36. NUMBER OF CALLS FROM x 25 =

AP USERS (WITHOUT _____ _____ _____

40-CHARACTER DISPLAY TERMINALS)

Number of times per hour that ISDN users without 40-character

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display terminals initiate an EDS or MSS session at the SM-2000.

37. NUMBER OF CALLS FROM x 33 =

AP USERS (WITH _____ _____ _____

40-CHARACTER DISPLAY TERMINALS)

Number of times per hour that ISDN users with 40-character display terminals initiate an EDS or MSS session at the SM-2000.

DIGITAL ATTENDANTS

38. NUMBER OF CALLS WHICH USE x 81 =

DIGITAL ATTENDANT _____ _____ _____

Number of times per hour that attendant 1- and 2-way calls split with bridge are made. This item is applicable if attendants using ISDN consoles are located on the SM-2000.

39. NUMBER OF CALLS WHICH USE x 18 =

DIGITAL MESSAGE SERVICE_____ _____ _____

SYSTEM (MSS) ATTENDANT

Number of times per hour that attendant MSS call coverage calls are made on this SM-2000. The assumption is that the digital MSS attendant is always logged onto the AP by way of a packet or circuit switch data call to monitor or insert messages. This item is applicable if attendants using ISDN consoles are located on the SM-2000.

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40. NUMBER OF CALLS WHICH USE x 28 =

ACD/BRCS AGENT _____ _____ _____

Number of calls per hour terminating to, or originating from, ACD/BRCS agents on this SM-2000.

Note: If the SM-2000 has OSPS/CACD traffic as well as ACD/BRCS traffic, the call counts for both types of ACD traffic can be combined in this item. However, this worksheet does not account for any other OSPS traffic, and therefore, if other OSPS traffic exists on this SM-2000, the worksheet will not provide an accurate result for the call capacity of this SM-2000.

A and B should be entered in these formulas in decimal fractions.

Sum of YOUR INPUT (items 5 through 40) ==> |C: _____ |

Sum of SM-2000 REAL-TIME CONTRIBUTION (items 5 through 40) ==>|D: _____ |

CALL CAPACITY CALCULATIONS AT 90 PERCENT OCCUPANCY

A+B Should be entered as decimal fractions in the following

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formulas.

CORE40

3,600,000 x (0.9 - (0.06 + 1.2xA_____))

---------- = _____ calls per hour

D_____

1.45 x 2 x ----------

C_____

CORE60

3,600,000 x (0.9 - B_____)

---------- = _____ calls per hour

D_____

2 x ----------

C_____

Note: A = Overhead from line units

B = No load occupancy in decimal fraction form

C = Total number of (O+T) calls per hour

D = Total real time used by the offered load

CORE60MM
The CORE60MM is calculated the same as CORE60 and adjusted by a factor of 1.2.

call capacity = CORE60 calls per hour * 1.2

PERCENT OF CALL CAPACITY

USED BY THE OFFERED LOAD

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CORE40

1.45 x D_____

---------- x 100 = _____%

3,600,000 x (0.9 - (0.06 + 1.2xA_____))

CORE60

D_____

---------- x 100 = _____%

3,600,000 x (0.9 - (B_____))

CORE60MM

The CORE60MM is calculated the same as CORE60 and adjusted by a factor of 1.2.

CORE60 percent capacity / 1.2

If these calculations indicate a call capacity occupancy greater than 90%, it is recommended that you deload your SM-2000.

12.4 SM-2000 MEMORY

Information regarding SM□2000 memory parameters for the latest software release can be found in Section 10.4

12.5 DIGITAL NETWORK UNIT - SONET

The Digital Network Unit - SONET (DNU-S) is a peripheral interface unit for trunks replacing the DLTU in the SM-2000, and Remote TR303 lines. The primary function of this unit is to terminate SONET facilities and to convert data and signaling to the Peripheral Control and Timing (PCT) link format for the SM-2000. All information is passed between the DNU-S and the SM-2000 over these PCT links.

The following Digital Networking Unit-SONET (DNU-S) items are engineerable:

- **STSX-1 Link Interface (SLI)** STSX-1 Link Interface (SLI)-Each SLI terminates one STSX-1 link. A minimum of 1 and a maximum of 12 may be equipped per unit. 5E11 and then 5E13 software releases permitted the use of two and then three DNU-S units in the SM-2000, expanding the usable number of STX-1 links to 24 and then to 36. Usable trunks have been increased to 16,128 with 5E11 and then again to 24,192 with 5E13.

- **STSX-1 Link Interface (SFI)**Two SFIs are provided in each data group of TMUXs. A minimum of 2 OR a maximum of 4 are provided per unit.

- **Transmission Multiplexer (TMUX)** TMUXs are provided one per PCT link plus one spare for each

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group of 6 TMUXs. A minimum of 2 OR a maximum of 14 are provided per unit.

- **Common Control (CC)** Each DNUS comes equipped with two Common Control (CC) boards
- **Common Data (CD)** A minimum of two OR a maximum of 4 CD boards may be provided per DNUS unit.
- **Common Optical Termination (COT)** A maximum of 24 COT boards may be provided per DNUS unit. Each COT terminates the optical fibers for 1 PCT link and performs the optical-to-electrical (and vice versa) conversion of data and control received and transmitted over the PCT link interfaces
- **Peripheral Link Interface (PLI)**Each side of a duplex PCT link terminates on a Peripheral Link Interface (PLI) paddle board at the SM-2000.

Table 12-1 describes the pack count for a single DNU-S at varying quantities of STSX-1s. Each STSX-1 is terminated by an SLI. The table assumes the most economical equipage of TMUXs, and buys the second spare only after the first data group is fully equipped.

Table 12-1 Pack Count for Single DNU-S

SLI (STSX-1)	SFI	TMUX	CC	CD	COT	PLI
1	2	1	2	2	2	2
2	2	2	2	2	4	4
3	2	3	2	2	6	6
4	2	4	2	2	8	8
5	2	5	2	2	10	10
6	2	6	2	2	12	12
7	4	7	2	4	14	14
8	4	8	2	4	16	16
9	4	9	2	4	18	18
10	4	10	2	4	20	20
11	4	11	2	4	22	22
12	4	12	2	4	24	24

Table 12-2 shows the SM-2000 engineering for the DNU-S.

Table 12-2 DNU-S Engineering for 100 Percent Inter SM Traffic

PCT PER SM	TRUNKS PER DNU-S [a]	DNU-S PER SM-2000 [a]	NCT2 PAIRS PER SM-2000 [a]	TSIS PER SM-2000 [a]
1	672	1	1	2
2	1,344	1	2	2
3	2,016	1	2	3
4	2,688	1	3	3
5	3,360	1	4	4
6	4,032	1	4	5
7	4,704	1	5	5
8	5,376	1	6	6
9	6,048	1	6	7
10	6,720	1	7	7
11	7,392	1	8	8
12	8,064	1	8	8
13	8,064+672	2	9	9
14	8,064+1,344	2	10	9
15	8,064+2,016	2	10	10
16	8,064+2,688	2	11	10

Notes:

a. Equal time slots on the peripheral and network sides. (square)

The SM-2000 is offered with a non-square TSI. The peripheral-to-peripheral feature enables a trunk (or line) to talk to another trunk (or line) without using any network side time slots, as long as the calls originate and terminate on the same SM-2000. Square engineering on an SM requires 2 peripheral time slots and 2 network time slots even if the calls originate and terminate on the same SM.

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Tables 12-3 and 12-4 show the equipment required for 50 and 100 percent tandem trunk traffic within the same SM-2000 respectively. Note the number of TSISs decreases as the tandem traffic increases.

Table 12-3 50 Percent Intra SM Tandem Trunk Traffic

PCT PER SM	TRUNKS PER DNU-S	DNU-S PER SM-2000	NCT2 PER SM-2000	TRUNKS PER SM-2000	TSIS PER SM-2000
1	672	1	0.6563	672	2
2	1,344	1	1.3125	1,344	2
3	2,016	1	1.9688	2,016	3
4	2,688	1	2.6250	2,688	3
5	3,360	1	3.2813	3,360	3
6	4,032	1	3.9375	4,032	4
7	4,704	1	4.5938	4,704	4
8	5,376	1	5.2500	5,376	4
9	6,048	1	5.9063	6,048	5
10	6,720	1	6.5625	6,720	5
11	7,392	1	7.2188	7,392	6
12	8,064	1	7.8750	8,064	6
13	8,064+672	2	8.5313	8,736	7
14	8,064+1,344	2	9.1875	9,408	7
15	8,064+2,016	2	9.8438	10,080	8
16	8,064+2,688	2	10.5000	10,752	8
17	8,064+3,360	2	11.1563	11,424	8
18	8,064+4,032	2	11.8125	12,096	9

Table 12-4 100 Percent Intra SM Tandem Trunk Traffic

PCT PER SM	TRUNKS PER DNU-S	DNU-S PER SM-2000	NCT2 PER SM-2000	TRUNKS PER SM-2000	TSIS PER SM-2000
1	672	1	0	672	2
2	1,344	1	0	1,344	2
3	2,016	1	0	2,016	2
4	2,688	1	0	2,688	2
5	3,360	1	0	3,360	3
6	4,032	1	0	4,032	3
7	4,704	1	0	4,704	3
8	5,376	1	0	5,376	3
9	6,048	1	0	6,048	4
10	6,720	1	0	6,720	4
11	7,392	1	0	7,392	4
12	8,064	1	0	8,064	4
13	8,064+672	2	0	8,736	5
14	8,064+1,344	2	0	9,408	5
15	8,064+2,016	2	0	10,080	5
16	8,064+2,688	2	0	10,752	5
17	8,064+3,360	2	0	11,424	6
18	8,064+4,032	2	0	12,096	6

12.5.1 TR-303 Interface on DNU-S

12.5.1.1 Feature Overview

Currently IDCU is used to terminate the TR303 RT lines. TR303 is industry standard and RTs may not always be a Lucent product. The DNU-S is used to terminate the SONET high speed trunks in the 5E software releases. With the introduction of this feature, the Remote lines can terminate on DNU-S which provides Peripheral Controller and Timing (PCT) links with multiple functionalities. TR303 connections from RTs terminate on Digital Access and Cross Connect System (DACS). From the DACS, STSX-1(s) connect to the DNU-S. The DNU-S is connected to the TSIU via PCT links. TR303 Embedded Operations Channel (EOC), Timeslot Management Channel (TMC), Basic Rate Interface (BRI) D-channel(s) and Permanent Packet B channel(s) are nailed up to the Packet Switch Unit (PSU) via Data fanout Multiple Peripheral Interface Data Bus (DFMP), or Data Fanout PCT known as DF2. No Directly Peripheral Interface Data Bus (DPIDB) connections are used.

This feature represents a conjoining of two evolution paths. The DNU-S evolution path started with the development of the hardware platform for digital trunks. The long term view of the DNU-S is that it will

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become the single interface unit for DS1 or higher rate based services. This includes digital trunks and IDLC lines. The NGDLC evolution path started with the development of the line TR-303 interface followed by the introduction of the 2048 line TR-303 interface. Given that most NGDLC systems are SONET based, it is a natural step to provide a SONET interface on the switch to match.

Currently the DNU-S on the SM-2000 has a limitation of 28,800 analog line terminations. As touched on in previous sections, the TR-303 interface on DNU-S feature has the potential to easily surpass this limitation. As a result of the need to present a complete SM-2000 solution for line terminations, a new feature focussed on scaling the analog line terminations to the relation size maximum capacity of 64K. TR-303 on DNU-S feature provides the capability to assign a TR-303 Remote Digital Terminal (RDT) to DS1 facilities terminating on a DNU-S (contained with an EC-1). The *5ESS*® switch will provide the equivalent capabilities and services for TR-303 RDTs on a DNU-S as for those on an IDCU with the exception of DS1 maintenance capabilities, PLS, and Hairpins.

The DNU-S is designed to connect to transmission equipment via EC-1 interfaces. DDM-2000, *SLC*® 2000, and DACS IV-2000 support the EC-1 interface. In addition, DDM-2000, *SLC*® 2000 and DACS-IV-2000 currently support the OC-3 interface. This feature allows the *5ESS*® switch to terminate DS1 based TR-303 RDTs that interface to the DNU-S by mapping the DS1s asynchronously into SONET VT1.5s, multiplexed up to an EC-1.

12.5.1.2 Transparency Issues

The DNU-S TR-303 interface to the RDT is transparent with the IDCU TR-303 interface with the following exceptions:

(1) DS1 Protection Line Switching (PLS). Since there are no physical DS1s present in the configuration, PLS is not needed. For applications where PLS is needed, the customer may choose to deploy RDT on an IDCU, instead of the DNU-S. As a consequence of not supporting PLS, DS1 Bit Error Rate (BER) is not be supported.

(2) DS1 Loopbacks are not required to be supported for the same reason as PLS.

(3) Hairpins are not supported for the DNU-S Interface. The ability to provide this feature requires a TSI that the DNU-S does not support.

Although TR-303 interface on DNU-S uses a different external name, DS1SFAC, for TR-303 DS1s interface on the DNU-S, the user will observe equivalent TR-303 interface functionality on the DNU-S as is currently found on the IDCU. The internal operations for the DNU-S differ from that of the TR-303 operation on the IDCU. Differences here are characterized as providing equivalent functionality without redesigning the current DNU-S OA&M design.

For clarity, the TR-303 interface on DNU-S feature does not provide the TR-008 functionality found on the IDCU. Since DNU-S does not support TR-008, the ability to perform "RT Conversions" on the DNU-S is not supported. TR-008 RDTs are required to follow the Degrowth procedure for TR-008 RDTs then add the equipment to DNU-S following DNU-S Growth procedures for TR-303 RDTs. In addition, the external craft interface will see some differences e.g. the I/O commands make use of unit identifiers. IDCU and DNU-S are part of the the command string to specify which type of unit the TR-303 line is being served from.

12.5.2 Administration

Traffic usage, maintenance usage, call attempts, and Blocked Call Indication (BCI) reports are collected for each RDT. This involves creation of new reports to provide equivalent reporting capability. Since there is no blocking between the DNU-S and the SM-2000, this data is not required for the DNU-S itself.

- Print number of TRFC30 report attempts, usage, and time slot quantities per RDT.

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- Initiate Subscriber Line Busy (SLB) studies for DNU-S lines.
- Initiate Blocked Call Indication (BCI) reports for DNU-S lines
- Collect measurements of usage and attempts for lines on a DNU-S

12.6 DIGITAL LINE TRUNK UNIT 2 (DLTU 2)

A Digital Line Trunk Unit 2 (DLTU2) consists of 10 DFI2 circuits. Each DFI2 terminates either a single or two T1 (24 channel) facilities per circuit pack. A maximum of 6 DLTU2s would be possible on an SM-2000 switch module. This allows 120 T1s (24 X 120) or 2880 trunks per SM-2000. This is increased from the SM limitation of 1 DLTU2 and 480 trunks per SM. The number of trunk T1s is reduced by the number of facilities that are used for RSMs. For an overview of DLTU, refer to the discussion in DIGITAL LINE AND TRUNK UNIT, Section 10.11 .

12.7 DIGITAL SERVICE UNIT 3 (DSU3)

The DSC3 provides roughly four times the capacity of the classic DSC. The DSU3 provides the Local Digital Service Unit Function (LDSUF). Each DSC3 board contains 10 Digital Signal Processors (DSPs). Each DSC3 circuit pack is a service group (SG) containing 4 duplex PIDBs, providing 128 time slots terminating to a DX board. Two DSC3s are required. These terminate on the first DX board. Up to 6 additional DSC3s may terminate on any DX board having ports available. All PIDBs from one DSC3 must be on the same DX board. Functional usage of the DSP types depends upon the market although there is some common usage. Table 12-5 shows DSP functions versus DSP types.

Table 12-5 Local DSU Functions

DSP TYPE	FUNCTIONS
Digit Receptor	Touch Tone Dial Pulse Multi-Frequency CAMA
Tone Outpulser	Generalized Tone Outpulser Inband Multiwink Signaling Incoming Calling Line Identification Message Waiting Indicator
Tone Transceiver	Voice Path Assurance
Voice Band Data Service	Analog Incoming Calling Line Identification Analog Visual Message Waiting Indicator

12.7.1 DSC3 Limits per DSC3

- 10 DSPs
- 128 incoming and 128 outgoing time slots
- 4 duplex PIDBs
- 1 duplex PICB.

12.7.2 Digit Receptors (DRs) per DSC3

- Each DR type DSP uses 16 incoming time slots.
- A maximum of 8 DSPs may be DR type DSP per DSC3 board.

The usage for Touch-Tone, Multi-Frequency, dial pulse and ASI- PROXY is determined by:

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Calls x holding time / 100 = CCS for decoders

This usage is then read into a Poison table (P.01) and the number of servers required is determined. These servers divided by 16 determine the DSPs that should be DR type. Two additional DSPs should be provided if CAMA trunks are in the SM-2000.

12.7.3 Tone Outpulser (TO) per DSC3

Two DSPs per DSC3 can be TO type DSPs for 128 outgoing time slots. These 128 time slots are decremented by the outgoing time slots required by the tone transceiver (TTR) type DSPs. A minimum of 18 TO type time slots must remain for the tone outpulsing feature alone in the DSU3 (18 on each of the first 2 DSCs).

12.7.4 Tone Transceiver Per DSC3

A maximum of 8 DSPs may be TTR type per DSC3, but at least 2 DSC boards per SM-2000 are limited at 7 DSPs per DSC3 because of the time slots for tone generation. Tone transceivers are located in both the DSU-2 and DSU-3 units.

12.7.5 Voice Band Data Services (VBS) per DSC3

- A maximum of 8 DSPs per DSC3 board may be VBS
- Each VBS DSP can support up to 8 outgoing channels
- VBS does not require incoming time slots
- Traffic counts are provided for this DSP type.

12.7.6 Combinations per DSC3

- The sum of the TTR plus the DR plus DSPs must not exceed 8 on any one DSC3 board
- If a TTR type is required by VPA, two DSPs should be sufficient inasmuch as they provide 732 CCS.
- A minimum of 2 and a maximum of 6 DSC3 boards can be provided per SM-2000. The DSC3s operate in a service group load sharing active-active mode.
- A minimum of 18 TO type time slots must be available on 2 DSC3s.

12.7.7 Local Digital Service Unit Function (LDSUF)

Eight or 24 PIDBs are reserved for DSC3s when the first or sixth DX circuit packs, respectively, are equipped.

12.7.8 Technology Upgraded LDSF

The Technology Upgraded Local Digital Service Function provides a single hardware platform and resident software image for the Local Digital Service Function (LDSF) of tone generation, tone decoding and signaling on both the SM and SM-2000. The new version of the LDSF uses smarter Digital Signal Processors (DSPs) to perform the required functions. This pack is designated as a TN1890 and replaces the TN 833C in the SM. For the SM-2000, the new version of the LDSF is designated as a UN590, and replaces the UN363. The TN1890 pack is compatible with all DSU-2 and the UN590 with DSU-3 hardware. Its use is designed to be ***totally transparent*** to Call Processing, Recent Change, and Office Data Base information.

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12.8 HOST SWITCHING MODULE ON SM-2000

The Host Switching Module (HSM) on SM-2000 feature extends the capability of the SM-2000 to support RSMs . The HSM-2000 is an evolution of the HSM which supports 30 RSMs compared to a maximum of 5 RSMs supported on existing HSMs. The HSM-2000 feature provides the capability to remote an RSM from a host SM-2000 via standard 24 channel T1 lines.

The HSM-2000 feature provides the functionality of an SM-2000 as a host to RSMs. Figure 12-1 presents a high level view of the HSM-2000 switch.

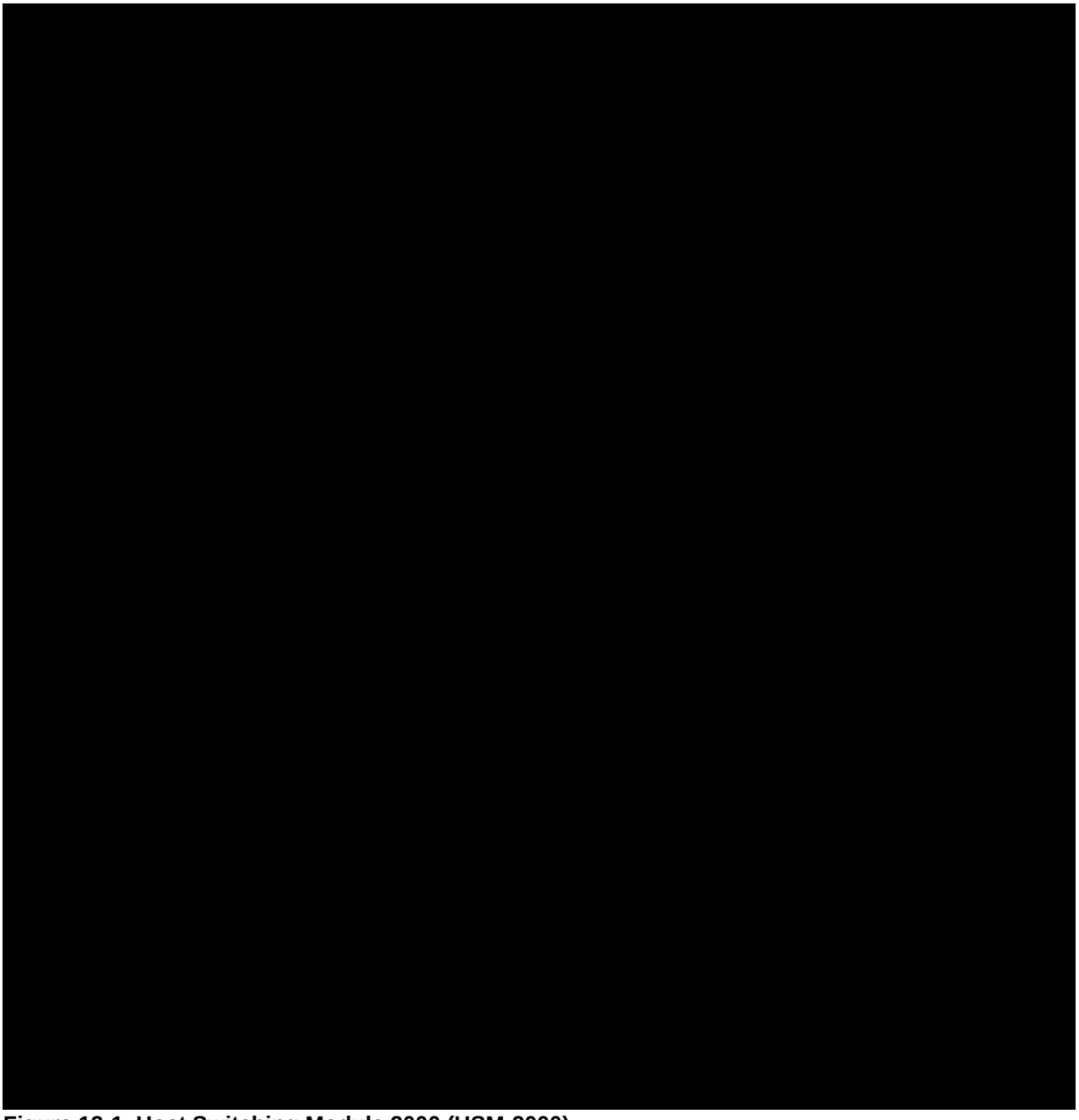

Figure 12-1 Host Switching Module 2000 (HSM-2000)

12.8.1 Host Switching Module Requirements

The HSM-2000 feature provides the capability to remote an RSM from a host SM-2000 via standard 24 channel T1 lines. The HSM-2000 uses 24 channel T1 lines to subtend the RSM, and is an evolution of the

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HSM, intended to extend all the services provided by a HSM to a greater number (30) of RSMs, compared to the maximum of 5 RSMs that the existing HSMs can subtend.

This feature is concerned with the operation of an SM-2000 as host to RSMs. As with HSM, the HSM-2000 is the interface between the subtending RSMs and the Communication module in the host office. The HSM-2000 must provide a conduit for timing and control links to the subtending RSMs, and also provide access to the network. In practice, the timing source for the RSM is done at the Facility Interface Unit, (FIU), and the role in this for the HSM-2000, as with the SMs, is to ensure that at the near end, the HDFIs are initialized/synchronized; the T1s umbilicals terminating on the HDFIs provide input to the RSM timing selection process.

For control, the HSM-2000 must, like its counterpart, route the Control Time Slots (CTS), (two active or two active with two standby p per RSM) to the RSMs. Since an HSM-2000 can subtend up to 30 RSMs, it must be capable of administering the Control Time Slots for the RSMs.

This capability extends the current ability of HSMs to support a maximum of 5 RSMs, each of which is subtended from 2 to 4 standard T1 lines. It must be recognized that any RSM may be subtended from the HSM or HSM-2000 by from two to twenty T1 lines, with 4 T1 lines being typical. To subtend 30 RSMs from an HSM-2000, the minimum of two T1 lines must be enforced. No design decision must be made which would foreclose the ability of HSM-2000 to subtend more than 30 RSMs. The current thinking is that the ability to subtend up to 30 RSMs represents the bulk of the known market. The HSM-2000 is able to subtend a single RSM with 2 to 20 T1 links.

12.8.1.1 Initialization Requirements

All RSM(s) subtending from an HSM-2000 must be capable of being fully initialized (without pump) without disrupting stable calls on the HSM-2000. If RSM(s) subtending from an HSM-2000 is fully initialized with pump, calls in the HSM-2000, which occupy the pump time slots, is affected (for example, torn down) if the time slot is borrowed for pump. Stable calls from the initializing RSM(s), passing through the HSM-2000 are also be dropped. This is the current applicable scheme for pump an RSM subtending from an HSM.

HSM-2000 must be capable of full initialization without disrupting transient or stable calls in its subtending RSM(s), with the following exceptions:

- Calls passing through the HSM-2000 are torn down during HSM initialization.
- Subtending RSM(s) may go into stand-alone during HSM-2000 initialization. When HSM-2000 initialization occurs, the stand-alone interval of the subtending RSM(s) must not exceed the HSM-2000 initialization interval.

HSM-2000 must be capable of full-initialization without disrupting transient calls in its subtending RSM(s). An HSM-2000 full initialization with pump shall not take longer than 5 minutes.

Umbilical connectivity exercises must pass ATP, if both host and remote ends are active and the umbilical is connected correctly. Umbilical connectivity exercises fail if the umbilical is connected incorrectly or looped at either end.

If redundant CTS channels are provided, craft or fault recovery requests to take a CTS umbilical out of service must cause a switch of the CTS to the designated mate umbilical. Performance monitoring is the systematic monitoring (or tracking) of a particular entity's health through the continuous collection and analysis of data derived by observing the entity's performance.

In order to provide end-to-end performance measurement of the umbilicals subtending RSM(s) from an HSM-2000, performance data must be collected and analyzed in order to detect performance degradation and provide a basis for network maintenance. For HSM-2000, performance monitoring refers to the set of actions needed to collect, store, threshold, and report end-to-end performance of the umbilicals between it

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and the subtending RSM(s). The HSM-2000 must provide continuous performance monitoring of all HDFI facilities to subtending RSMs.

12.9 OPTICAL INTERFACE UNIT (OIU)

12.9.1 OVERVIEW

The optical interface unit (OIU) is a peripheral unit of the *5ESS*® switch that interfaces to high speed Synchronous Optical Network (SONET) multiplexers via optical OC-3/OC-3c links.

The OIU performs the following functions:

- Terminates point-to-point intra-office OC-3, OC-3c, or optical facilities from SONET multiplexer equipment.
- Supports TDM and voice over IP applications.
- Supports 1+1 Automatic Protection Switching (APS) for both the optical facility and pack.
- Maps the signaling and bearer channels of the incoming optical facility onto a peripheral control and timing (PCT) link interface to the SM-2000.

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- Carries control messages over dedicated PCT time slots between the OFI and the MH/MHPPC
- Provides signaling between offices via the SS7 network using different methods, including the integrated services user part (ISUP) protocol , primary rate interface (PRI), and multifrequency (MF) for TDM trunks; and SIP for IP packet trunks
- Provides significant savings in floor space, power consumption, and equipment costs
- Provides integrated *5ESS*® switch Operations Administration Maintenance and Provisioning (OA&M) functions.
- Provides a foundation architecture for increased capacity and future evolution.

12.9.2 TRANSITION MANAGEMENT

12.9.2.1 Feature Availability

Release	Feature	Description
5E16.2	99-5E-7140	OIU-NAR (OC-3)
5E16.2 FR3	99-5E-8308	OIU-IP (OC-3c)
5E16.2 FR4	99-5E-8414	OIU-GR303 (GR303 on OIU)
	99-5E-8415	OIU-EAIU (EAIU on OIU)
	97-5E-8565	OIU Semi-Integrated Echo Cancellation

12.9.2.2 Special Growth Considerations

- OIU-IP requires feature 99-5E-8382 SIP for Packet Trunking. Refer to 235-200-118 *Session Initiation Protocol for Packet Trunking - OA&M Manual* for more detailed information on SIP.

12.9.3 ENGINEERING CONSIDERATIONS

12.9.3.1 Architecture and Interfaces

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Refer to 235-100-200 *Hardware Description* for a functional description of the OIU hardware.

12.9.3.2 Supported Hardware Platforms

- The OIU is only supported on SM-2000s due to the PCT links and MH call control required (includes DRM, EXM, and VCDX).
- The OIU-IP is currently only supported on a local SM-2000 (and EXM provided the EXM is not configured for standalone). The OIU-IP is not supported on DRM, CDX, or VCDX due to the SIP signaling and QLPS required.

12.9.3.3 Supported Remote Interfaces

The following remote interfaces are currently supported:

Supported	Not Supported
GR303/TR303	TR008
EAIU	RISLU/RISLU2
PRI	RSM Umbilicals

- GR303 (also sometimes referred to as TR303) is a Telecordia defined interface between the Local Switch and systems that provide access to remote phone subscribers. These systems are called Digital Loop Carriers or Remote Terminals. The OIU supports all the the GR303 features, signaling, protocol, and service classes that are currently supported on the DNU-S.
- The same OC-3 may be used to terminate multiplexed GR303 interfaces, EAIUs, SDLs, and inter-office trunking applications.
- Since all facilities of an EAIU or GR303 interface must terminate on the same SM, they may terminate

on different OFI pairs provided that all the OFIs connect to the same SM.

12.9.3.4 Shelf and Cabinet Configuration

Traditional *5ESS*® switch peripheral units required one hardware shelf/sub-rack, so the logical unit was synonymous with the physical unit. In order to effectively use the high trunk density of the OIU, a separation of the logical from the physical unit representation was required, which enables multiple logical OIUs from different SM-2000s to share the same physical shelf.

The logical unit is called the OIU and the physical shelf is called the AnyMedia Interface Platform (AIP). An OIU is a logical collection of up to 10 pairs of OFI packs [called Protection Groups (PGs)] on the same physical AIP shelf. OFI PGs are independent of each other and can be logically grouped into OIU units, possibly owned by different SM-2000s.

A mapping scheme is provided to enable craft personnel to convert from a logical representation to actual physical locations by using an OP:CONV input message or referring to MCC pages 1490 and 1493.

- The AIP shelf has 22 slots numbered 1-22.

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- Slots 1 & 2 are not used by the OIU application. A blank faceplate is always equipped in these slots, and any unused OFI slot to maintain proper airflow.
- Slots 3-22 are grouped into adjacent slot pairs forming 10 OFI protection groups, numbered 0-9.
- An AIP shelf can be shared by up to 10 SM-2000s (1 SM-2000 per OFI pair).
- Up to 6 AIP shelves can be equipped in one cabinet (3 front, 3 back).

12.9.3.5 Pack Options

Application	Pack Code	Interface	Fiber Type	Transceiver	Ports
TDM	LPA931	OC-3	Single-Mode	Laser	3 PCT and 1 OC-3
IP	LPA935	OC-3c	Multi-Mode	LED	3 PCT and 1 OC-3c
	LPA936	OC-3c	Single-Mode	Laser	

- Each OFI interfaces with up to three PCT links and one OC-3/OC-3c facility via connectors on the OFI faceplate.
- The OFI-TDM and OFI-IP circuit packs can co-exist on the same shelf.

12.9.3.6 Spares

- OFI packs are always equipped as mated pairs.

12.9.3.7 PCT Engineering

- All PCT links equipped on a mated OFI pair must terminate on the same SM-2000.
- The first PCT link (PCT0) on each OFI is required to provide the OFI control and timing synchronization in addition to bearer traffic.
- The remaining two PCT links per OFI packs are equipped according to the traffic needs.

The number of engineerable PCT TSs is as follows:

Application	DS0s per PCT	Notes
OFI-TDM	672	A PCT link has 768 TSs, however only 672 may be used for traffic due to the TS mapping of the SONET OC-3.
OFI-IP	PCT0 = 720	768 TSs - 2 CTSs - 46 TSs reserved for pump and future In-Band Signaling applications
	PCT1 = 768	PCT0 + PCT1 = 1488 DS0s
	PCT2 = 528	PCT0 + PCT1 +PCT2 = 2016 DS0s

12.9.3.8 Capacities

12.9.3.8.1 Engineering Limits

A summary of engineering limits is as follows:

Engineering Parameter	Scaling Limit	
PCT Links per OFI	3	
Equivalent DS1 per PCT	28	
DS0s per PCT	**TDM**	672
	IP	PCT0 = 720
		PCT1 = 768

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	PCT2 = 528
DS0s per OC-3/OC-3c	2016
DS0s per OFI (1+1 APS pair)	2016
OFIs per Shelf (1+1 APS pair)	10
DS0s per Shelf	20,160
Shelves per Cabinet	6
DS0s per Cabinet	120,960

12.9.3.8.2 Voice over IP Capacities

For Voice over IP applications, there are tradeoffs in the DSP complex between memory and real-time resources. The tradeoff may result in the OIU-IP supporting less than 2016 simultaneous calls. In particular, these tradeoffs have an impact when considering the voice packetization interval, jitter buffer size, and the usage of silence suppression. There are also bandwidth limit considerations of the OC-3c link.

The following table summarizes the number of simultaneous calls supported by the DSP complex vs. jitter buffer size and payload size as well as the OC-3c bandwidth limits vs. usage of silence suppression.

VoIP Packetization interval (ms)	DSP Capacity			OC-3c Channel Capacity	
	Max Jitter Buffer Size is <= 90ms	Max Jitter Buffer Size is >90ms. and <= 160ms.	Max Jitter Buffer Size is > 160ms and <= 300ms.	No Silence Suppression	With Silence Suppression
10	2,016	1,760	1,520	1,250	1,870
20	2,016	1,760	1,520	1,520	2,016
30	2,016	1,760	1,520	1,640	2,016

- Voice packetization interval is provisionable as 10, 20, or 30ms., default = 20ms
- Jitter buffer size is provisionable from 10 to 300ms. in 5ms. increments, default = 90ms
- Silence suppression is provisionable, default = Yes.
- IP header compression and voice compression are not currently supported.
- Recent Change (RC/V) view 20.28 displays the Maximum Engineerable Timeslots (METS) value for an OIU-IP PG. METS is the lesser value between the PCT, DSP, and the OC-3c capacities.

12.9.3.9 Physical Limitations

- The cabinet will be associated with a single SM-2000 for the purpose of reporting power and fuse alarms.
- The cabinet will normally be located within the SM-2000 footprint, however a customer may also co-locate it with the transmission equipment provided cable length restrictions and proper 5ESS grounding is followed.
  - The OIU OC-3/OC-3c interface connects to co-located SONET/SDH transmission multiplexers and does not extend outside of the building.
  - Alarm cables are currently orderable from Lucent in lengths up to 500 feet
  - The maximum PCT cabling distance between any SM-2000 and the OIU is 2,000 feet.
- The cabinet can not be shared by other peripheral units due to physical design restrictions on mixing

optical and copper cables in the same cabinet.

12.9.4 SYSTEM RESOURCE IMPACTS

12.9.4.1 TSI Engineering

Each OFI PCT link will require a TSI port assigned as follows:

- Up to 3 PCTs from OFI 0 will terminate on TSI ports in Service Group 0
- Up to 3 PCTs from OFI 1 terminate on TSI ports in Service Group 1.

12.9.4.2 MH Engineering

The OFI control is provided by the Message Handler (MH) of the SM-2000.

The number of MH timeslots required to support the control and pump requirements of the various types of OFIs are shown below:

MH TSs Allocated	OFI-TDM	OFI-IP
Control TSs *(per OFI pair)*	2	2
Pump TSs *(per MH32)*	0	4
Pump TSs *(per MHPPC)*	0	16

The MH provides both TSs and software channels. In general there is a one-to-one mapping of a TS to a software channel with the following exceptions:

- MH diagnostics requires one channel; however, no TS is required
- Pump TSs require multiple TSs; however, only one channel is required

Whichever resource is exhausted first (TSs or channels) determines the engineerable capacity of the MH. This results in the following capacities:

Application Supported	MH32 Engineerable Timeslots	MHPPC Engineerable Timeslots
OIU-TDM Only	31	255
OIU-IP or OIU-TDM and OIU-IP	32	256

For example, to calculate the maximum number of OFI-IP pairs that can be supported by two MH32s, the following equation and guidelines can be used (if the MH32 capacity is exhausted, conversion to MHPPC will become necessary):
32 TSs - 4 Pump TSs = 28 TS per MH * 2 MHs =
56 TSs - DNU-S Control TSs - EAIU Control TSs =
Available MH TSs for OFIs
Available MH TSs for OFIs / 2 TSs per OFI Pair = Maximum OFI-IP pairs
(Based on MH Capacity: other constraints may apply).

12.9.4.3 Memory

Peripheral Image Optioning enables memory savings on SMs by only loading the specific text code required for the peripherals actually present. Each SM-2000 equipped with an OIU will require:

Peripheral Image Name	Text Usage	
	SM	SM2K
OIU24	N/A	882 KB

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12.9.4.4 Call Capacity

No impact.

12.9.4.5 Software Resources

12.9.5 ADMINISTRATION CONSIDERATIONS

12.9.5.1 Assignment Guidelines

OFI protection groups are always assigned to adjacent slots which are each fed by a different power bus for reliability.

The maximum number of Packet DS0s per SM2K is 11,040 (100% square TSI = 16 PCTs). In order to maximize the number of channels per SM2K when the PCT links are partially utilized, it may be necessary to distribute the channels more efficiently across the last two OFI-IP protection groups as illustrated in the example below:

12.9.5.2 Equipment Numbering

12.9.5.2.1 OIU-TDM

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The OIU-TDM Equipment Numbering is as follows:

AAA-B-C-D-E-F-G-HH		
AAA	sm	SM number (001-192)
B	oiu	Logical OIU number (0-7)
C	pg	Protection group number (0-9)
D	ste	OC-3 number (Always equal to 1)
E	hvc	STS-1 number (1-3)
F	lvcgroup	VT1.5 group number (1-7)
G	lvcmem	VT1.5 member number (1-4)
HH	ch	DS0 number (01-24)

12.9.5.2.2 OIU-IP

The OIU-IP Equipment Numbering is as follows:

AAA-B-C-D-E		
AAA	sm	SM number (001-192)
B	oiu	Logical OIU number (0-7)
C	pg	Protection group number (0-9)
D	ste	OC-3 number (Always equal to 1)
E	hvc	STS-3c number (Always equal to 1)

12.9.5.3 Traffic Measurements

The following Traffic Measurements are associated with the OIU:

Measurements	Report	Section
Bearer Link	TRFC30	208
Call Mix	TRFC30	253
IP OIU □ APS Measurements	TRFC30	260
IP OIU □ IP Statistics	TRFC30	259
Optical Interface Unit	TRFC30	81
Packet Group	TRFC30	211
Packetization Time Measurements	TRFC30	262
SIP	TRFC30	209
SCTP	TRFC30	210
Trunk Group	TRFC30	212

Refer to 235-600-750 *Output Messages Manual* for more information on these Traffic Reports.

12.9.5.4 Recent Change and Office Records

The following Recent Change Views, ODA Forms, and Office Records are associated with the OIU:

RC View	ODA Form	Office Record	Title
8.15	5509	5559	Office Options
8.29	5769	5769	Threshold Alarm Levels
19.27	□	5765	Anymedia Interface Platform
19.28	□	5760	Optical Interface Unit
20.28	□	5761	Optical Facility Interface Pack
20.29	□	5762	OIU Sonet Terminating Equipment
20.30	5763	5763	High Level Virtual Container
20.31	5764	5764	Low Level Virtual Container
20.32	5767	5767	OIU Performance Monitoring Threshold Group
20.33	5766	5766	Carrier Group Alarm Integration Times
33.1	□	5987	IP Processor Assignment
33.15	5935	5935	Bearer Network Definition

Refer to 235-080-100 *Translations Guide* and 235-080-100 *RC/V Manual* for more information.

12.9.6 OPERATIONAL SUPPORT SYSTEM IMPACTS

12.9.7 TOOL REFERENCES

Feature	TOPAZ Release
OIU	5
OIU-IP	9

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13. EXM-2000 UNIQUE RESOURCE UTILIZATION

13.1 DESCRIPTION

13.1.1 EXTENDED SWITCHING MODULE-2000

The Extended Switching Module-2000 (EXM-2000) is an optically remote SM-2000, somewhat analogous to the ORM in the SM configuration. The EXM-2000 supports optional stand alone capability and an optional Stratum 3 clock capability and is remoted from a CM2 using QLIs, NCT link formatted fiber optic, and TRCU2 equipment.

The EXM-2000 supports analog lines (LU3), digital trunks (DLTU2) for low speed interfaces, DNU-S for SONET high speed interface, and DSC3.

Examples of EXM-2000 applications include the following:

- Small analog switch replacements (4000 - 20,000 lines)
- New remote sites where large growth is expected, and using RSMs/ORMs will reach exhaust capacity
- Replacing Multi-Mode Remote Switching Module (MMRSM) configurations that are approaching exhaust (Approximately 10,000 lines)

13.2 ENGINEERING CONSIDERATIONS

See Section 12 , SM-2000 UNIQUE RESOURCE UTILIZATION, for a discussion of engineering considerations for the EXM-2000.

13.3 ASSIGNMENT GUIDELINES

See Section 12 , SM-2000 UNIQUE RESOURCE UTILIZATION, for a discussion of assignment guidelines for the EXM-2000.

13.4 FEATURE IMPACT

The impact of features on an EXM-2000 is similar as for an SM. The resources required to support features are similar to those provided in the SM and are discussed in the associated section of this manual.

13.5 TRANSITION IMPACT

The impact of features on an EXM-2000 is similar as for an SM. The resources required to support features are similar to those provided in the SM and are discussed in the associated section of this manual.

13.5.1 ABSTRACT

The SM-2000 is an evolution of the SM that provides a significant per time slot cost reduction, enhanced architecture, and platforms for new features/services. The cost reduction is achieved through the sharing of centralized resources over a significantly increased number of line and trunk terminations.

The EXM-2000, an optically remoted SM-2000, provides the capability to deliver SM-2000 functionality at a remote location. The functionality of EXM-2000 in the initial offering is circumscribed by the current planned capability of the SM-2000. The SM-2000 release supports analog lines, ISDN lines, and digital trunks. The EXM-2000 supports these interfaces also. The SM-2000, does not currently support all embedded base peripherals currently served by the classic SM. These functions not supported directly by

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the SM-2000 are provided by one or more SMs coexisting in the same office. The EXM-2000 accesses the functions provided by local SMs during normal operations. When an EXM-2000 is isolated from the host switch, only optional Stand Alone functionality is available.

EXM-2000 will not be available in cluster configuration. Those applications that require a cluster of *5ESS*® switching modules are served using existing MMRSMs (Multi-Module Remote Switching Modules) based on the Classic SMs.

Table 13-1 summarize features and hardware supported by SM-2000 and EXM-2000.

Table 13-1 Hardware Supported in Local and Remote SM-2000s

HARDWARE SUPPORTED	SM2K	EXM2K
AIU/EAIU/XAIU	□	□
DCLU	□	□
DCTU	□	□
DLTU/DLTU2	□	□
DNU-S	□	□
GDSF	□	□
IDCU	□	□
ISLU2	□	□
LDSF	□	□
LU2/LU3	□	□
MMSU	□	□
OIU-IP	□	
OIU-TDM	□	□
PSU2	□	□
SAS	□	□
TU	□	□
TRCU2		□
TRCU3		□

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14. ADMINISTRATIVE SERVICES MODULE (ASM) AND DISTINCTIVE REMOTE MODULE (DRM)

14.1 ADMINISTRATIVE SERVICES MODULE (ASM)

14.1.1 Overview

The *OneLink Manager™* Administrative Services Module (ASM) is an adjunct platform to the *5ESS®* switch, which enhances and evolves the administrative services of the *5ESS®* switch. Using commercially available software and hardware, the ASM provides open, high-speed interfaces and enhanced services in a traditional *5ESS®* switch environment.

14.1.2 Transition Management

Refer to 235-200-145 *OneLink Manager™ Administrative Services Module User's Guide*, for a current list of:

- Applications
- Features
- Software Release Dependencies
- Growth, Degrowth, and Conversions

14.1.3 Engineering Considerations

14.1.3.1 Architecture and Interfaces

14.1.3.2 Supported HW Platforms

The ASM is supported with the 3B21D AM.

14.1.3.3 Configurations

Refer to 235-200-145 *OneLink Manager™ Administrative Services Module User's Guide*, for currently supported configuration options and capacities.

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14.1.3.4 Physical Limitations

The ASM can be located up to 100 cable feet from AM.

14.1.4 System Resource Impacts

The ASM will communicate with the AM via the Dual Serial Channel Computer Interconnect (DCI).

14.1.5 Administration Considerations

The *5ESS*® Switch generates call detail records and transmits the records to the ASM, which formats them as AMADNS billing files, stores, and then transmits the billing records via TCP/IP to the Data Processing and Management System (DPMS). The DPMS is any system that processes the call detail records.

A table of AMA storage considerations for the ASM is provided in the Overview chapter of 235-200-146 *Administrative Service Module (ASM) Data Server Software Operating Guide*.

14.1.6 Operational Support Systems

The ASM supports a variety of Operational Support Systems via its high speed TCP/IP interface. Refer to 235-200-145 *OneLink Manager™ Administrative Services Module User's Guide* for more information on the OSS applications that are supported.

14.1.7 Tool References

Feature	TOPAZ Release
ASM	6
ASM2/HA-ASM	7
ASM3	9

14.2 DISTINCTIVE REMOTE MODULE (DRM)

14.2.1 Overview

The Distinctive Remote Module (DRM) is a remote switch module, whose cost has been reduced by the elimination of any bandwidth for voice/data connections on the umbilical to the host switch. Each DRM consists of a single SM-2000, a Sun Workstation, and a commercially remoted Ethernet connection to the host *5ESS*® switch. The remote SM is used to serve a customer group with little community of interest (i.e. infrequent need for connections) with other customers on the host *5ESS*® switch.

A DRM reduces the service provider annual cost for leasing umbilical facilities by approximately 1,000 percent, while not significantly increasing other costs to either the service provider or Lucent. The DRM extends the geographic limits of the *5ESS*® switch up to 2,000 miles by establishing a virtual switch consisting of self-contained call processing nodes integrated for operation and maintenance by an Element Manager running on the Administrative Service Module (ASM) of the host *5ESS*® switch.

Each DRM consists of a SM-2000 and a Sun Workstation (NETRA-T 1120). The DRM functions as a separate node in the switching network. Even though it is a remote vehicle it is specifically designed not to back-haul traffic to its host switch. The connections to the host switch are one DS1 and one optional BRI for DS1 backup. The back-up BRI will automatically establish a circuit switched data call to the PRI provisioned on the host Dynastar 500 if the DS1 facility is lost. The BRI may be provisioned on an AIU located within the DRM. The DS1 is connected to the workstation at the DRM location using a 10baseT connection, and terminated on the Administrative Services Module (ASM) in the host location using a 100baseT connection. The DS1 and optional BRI connections provide only craft and Operations, Administration, and Maintenance (OA&M) functionality. Note that the ASM must be equipped with a Quad Ethernet card prior to connecting a DRM to the host. Any ASMs shipped after April 3, 2000 are planned to

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be equipped with the Quad Ethernet card.

All peripherals that are supported on the SM-2000 are also supported on the DRM. Engineering of those peripherals follow the same engineering rules as are used in SM-2000 applications. The DRM does not employ the 3B21D, Communications Module, nor any hardware associated with the Communications Module (Communications Module Processor, Quad Link Packet Switch, and Quad Link Packet Switch Gateway Processors).

The Message Handler Ethernet Interface Bus (MHEIB) will be shipped with the SM-2000. The maximum number of SM-2000s in an office is 23, from which 15 may be DRMs.

The DRM Lucent networking component solution will focus on the connectivity of the DRM Administrative Workstation (AWS) at each remote sites to the ASM at the host site and to the operational services (OS).

Both host, remote and the OS sites require network connectivity equipment supporting following network protocols: WAN connectivity, ISDN, Ethernet/Fast Ethernet, Asynchronous/Synchronous connectivity, x.25, Internet Protocol (IP), standard IP routing protocol(s) and protocol translation/conversion (XOT). NEBS compliance is recommended for all the data network equipment.

The Lucent Networking Component Solution for DRM will consist of a Cajun P333T Ethernet switch and multiple Dynastar 500 Multi-Service Access Switches locating both at the host, remote and the OS sites.

The DRM is available as part of the 5E14 software release.

14.2.1.1 Networking Components

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14.2.1.1.1 Host Site

The Cajun P333T Ethernet switch has 24 auto-negotiation 10/100Base-TX ports and an expansion slot for additional 10/100Base-TX, 100Base-FX or 1000Base-X as needed.

The Dynastar 500 in a base configuration at the host site has the following components:

- 16 Sync/Async ports
- 1 ISDN PRI
- 7 T1s (with integrated CSU/DSU) dedicated for DRM and remote OS connectivity
- 1 Ethernet port (10 BaseT)
- Dual DC power supplies.

It is recommended that each Dynastar 500 support up to five DRMs. For a network with more than five DRMs, a Dynastar 500 with a Growth configuration can be used.

The Dynastar 500 in a growth configuration at the host site will have the following components:

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- 8 T1s (with integrated CSU/DSU) dedicated for DRM and remote OS connectivity.
- 1 Ethernet port (10 BaseT)
- Dual DC power supplies.

14.2.1.1.2 Remote Site

For connectivity to the DRM, a Dynastar 500 has the following configuration:

- 2 T1s (with integrated CSU/DSU) built-in to the chassis.
- 2 ISDN BRI
- 1 Ethernet port (10 BaseT)
- 16 Sync/Async ports
- Dual DC power supplies.

14.2.1.1.3 Operational Services (OS) Site

Since there are many different options and services available at the Operational Services (OS) site, it would be difficult to determine a one solution fits all cases. The following is a solution which customer can provide:

- 80 Sync/Async ports
- Dual DC power supplies
- 1 Ethernet port.

For connectivity to the OS site remotely, the above configuration is required in additional to the following:

- 1 T1 (with integrated CSU/DSU)
- ISDN BRI

14.2.2 Transition Management

14.2.2.1 New Generic

The DRM is available as part of the 5E14 software release. The Administrative Services Module (ASM must be equipped at the host site on order for the DRM to function.

14.2.3 Engineering Considerations

The following rules and recommendations apply:

- A DRM must be a SM-2000 (no MCTU2/MCTU3s or EXM-2000s allowed) usually containing an SMP60 or SMP60mm; however, an SMP40 can also be used.
- No TRCU2s or TRCU3s are allowed per DRM-2000.
- The minimum number of umbilicals (DS1s) used to connect a DRM to the host is one; the maximum is

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two. For reliability, two DS1s are recommended.

- DS1 links are used as data channels to download data from the ASM.
- A DRM must have a community of interest (no back-hauled traffic).
- A DRM can not be deployed beyond 2,000 miles from the host.
- Since the DRM does not derive its network clock synchronization from the CM, an external timing source should be provided. An optional Building Integrated Timing Source (BITS), which terminates on the TSIU4, can be used to provide internal Stratum 3 clock synchronization. Alternatively, external clock source can be provided by two external digital facilities.
- A maximum of 15 DRMs may be equipped per office depending on the number of remotes, lines and trunks.
- The DRM SM number must be different than the host office SMs.
- The frame relay device (FRAD), which is used to multiplex DS1s out of the ethernet link, is a transmission device which resides in the miscellaneous *5ESS*® switch cabinet. Any standard commercially available equipment which can remote 10BaseT Ethernet and up to 4 BX.25 data links can be used in place of the FRAD Switch.
- A DRM does not require CM or 3B21D.
- Since the DRM does not connect to the CM, no Quad Link Packet Switch (QLPS) is available on the DRM. The DRM-ASM Ethernet link capability is higher than the QLPS capacity of other SM-2000s.
- No network timeslots are required.
- DRM does not require inter-SM nail ups.
- A local MHEIB is equipped in MH slot 0, which resides in the SMPU unit.
- A DRM must have a SMPU5 unit, with the exception of older configurations (VCDX) that are equipped with SMPU4, and want to convert to DRM.
- A DRM can not host remote SMs.
- Although no traffic is back-hauled through the umbilical, the DRM and the host *5ESS*® switch can be interconnected via inter-office trunks.
- No inter-module trunks are allowed for the DRM.
- The TSI slice assignments for a DRM is the same as SM-2000 with the exception of network timeslots, since this feature does not require any network timeslot links.

  (1) Link 0 on TSI slice 0 is reserved for Message Pump and Control (MPC).

  (2) Link 1 on TSI slice 0 is used for Data Expansion board (DX).

  (3) Link 2 and 3 on TSI slice 0 is unassigned.

- All the trunk routing in the DRM is done locally.
- All the 3-way and 6-way conference capabilities are supported locally in the DRM.

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- The main connection at the host which supports the provisioning of up to 15 DRMs is the ASM.
- The SS7 signaling is done via PSU2 (no CNI connection).
- The maximum number of analog lines allowed per DRM is 28,800 (traffic engineerable).
- The maximum number of ISDN lines allowed per DRM is 3,840 (traffic engineerable).
- The maximum number of trunks allowed per DRM is 24,192 (traffic engineerable).
- The engineering of DRM is based on 100 percent non-square TSI format (no network timeslot allowed).
- The OS data links may be local off of the DRM Sun Workstation or remote off of the ASM.
- A DRM can be used for wireless applications.

14.2.4 System Resource Impacts

There are no resource impact issues associated with the DRM.

14.2.5 Administration Considerations

14.2.5.1 Traffic Capacity

The following impacts apply

- The measurements are maintained on a per-DRM basis
- The traffic and plant measurements are the same as 5ESS/VCDX
- The DRM measurements are as complete as the *5ESS*® switch measurements, with the exception of hardware that DRM does not support (e.g., CNI, CM2, 3B21D) or features that are not supported by DRM (e.g., RTCD, OSPS).
- Per-DRM measurements can be logged by the ASM.
- Existing Control Timeslots (CTS) usage counts, which are currently provided for all SMs, will also be used for the DRM.

14.2.6 Operational Support Systems

- The OSS functionalists, which require high speed TCP/IP connections (e.g., SCANs, BillDATS) are performed in the ASM.
- The OSS data links may be local off of the DRM Sun Workstation or remote off of the ASM.

14.2.7 Tool References

There are no tool issues associated with the DRM.

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15. ISDN RESOURCE UTILIZATION

The architecture, design, and implementation of the Integrated Services Digital Network (ISDN) in the *5ESS*® switch impose unique requirements and demand complicated procedures in the daily administration of the switch. This is especially true for the task of line assignment. The requirements and resulting procedures accommodating them are derived by combining two different types of switching, packet and circuit, in a single BRI/DSL. The two switching types each use different switch resources, the utilization of which is driven by the assignment of the single interface.

This document provides a description of the duality of ISDN in the *5ESS*® switch and itemizes the resulting requirements imposed by ISDN on the line assignment process. It also presents an assignment methodology that addresses those requirements.

A brief description of the line assignment task is provided to give the reader a conceptual understanding of its objectives and parameters. The architecture of ISDN in the *5ESS*® switch is then reviewed, but with emphasis placed on the limited switch resources that are the source of assignment constraints. Finally, a description is provided of the BRI/DSL assignment methodology that supports the assignment objectives and addresses the switch constraints previously described.

This section describes the ISDN considerations for ISLU, RISLU, IDCU, and PSU. ISDN engineering and assignment considerations for the AIU platform are currently contained in the AIU unit sections and will not be repeated here.

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15.1 ISDN SWITCHING MODULE

15.1.1 ISDN SWITCHING MODULE

Figure 15.1-1 ISDN SM Architecture

An illustration of an Integrated Services Digital Network (ISDN) Switching Module (SM) is provided in Figure 15.1-1 . The ISDN SM has three unique components that distinguish it from a standard SM:

(1) Equipped with a Packet Switch Unit

(2) Loaded with the ISDN Software Image

(3) Terminates ISDN:

- BRIs on an AIU, EAIU, XAIU, or ISLU2
- BRIs via TR-303 RDTs on an IDCU, DNU-S, or OIU
- PRIs on a DLTU2, DNU-S, or OIU.

NOTE: The commercial centrex automatic call distribution, *PINNACLE*® ACD, application on the *5ESS* ® switch does not require a dedicated SM. The *PINNACLE*® ACD service and other ISDN applications can be served from the same ISDN SM. The *PINNACLE*® ACD should always be considered as an ISDN centrex business services application rather than a unique application.

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15.1.2 ISDN Terminology

In the remaining sections, several terms are used that may be unfamiliar to the reader. These terms are defined as follows:

- ***Basic Rate Interface (BRI):*** The BRI provides the digital subscriber line interface to 3 digital channels. This interface provides 2 B-channels that communicate digitized voice or data. Also, a single D-channel that is used for controlling signaling and packet-switched data.
- ***2B+D:*** The term 2B+D is often used to define the BRI/DSL. Each B-channel on the BRI/DSL has a transmission rate of 64 Kbps and the single D-channel has a transmission rate of 16 Kbps.
- ***Z-card:*** The Z-card provides an interface for standard analog lines into the ISLU. This allows a mixture of digital and analog lines to be served from the ISLU. The use of the Z-card reduces the number of digital lines that may be served from the ISLU.
- ***T-card:*** The T-card provides a 4-wire BRI/DSL connection into the ISLU. The distance between the customer terminal and the ISLU is limited, in terms of loss, to 6 dB at 96 kHz.
- ***U-card:*** The U-card provides a 2-wire BRI/DSL connection into the ISLU. The distance between the customer terminal and the ISLU is limited in terms of dB loss.
  - AMI U-card – The loss for the AMI U-card is 32 dB at 80 kHz. This allows a longer loop than possible with the T-card. A network termination 1 (NT1) adapter may be used to convert from a 4-wire customer terminal to a U-card interface. Some terminals have built-in NT1s, therefore U-cards are required for those.
  - *ANSI*® U-card – Performs similar functions to the current Lucent Technologies AMI U-card but with a transmission format compatible with T1D1 U-interface standard. The *ANSI*® U-card requires an NT1 compatible with the T1D1 standard interface.
- ***Q.931 Protocol:*** The Q.931 protocol is used on the D-channel to provide signaling information for communications on the B-channels.
- ***X.25 Protocol:*** The X.25 protocol is a layered protocol used in the ISDN environment to transmit data calls on B- or D-channels in the form of data packets. The protocol layers include the electrical (hardware) level, a link access level, and a packet transfer level.
- ***Virtual Circuit:*** A virtual circuit is a logical connection across the ISDN packet network that emulates a point-to-point physical circuit. The virtual circuit ensures data integrity, transparency, and sequencing.

15.1.3 Fractional DS1 (NxDS0) Switching

The Fractional DS1 Switching provides the capability to establish calls at rates between 128 Kbps and 1536 Kbps (2 to 24 DS0s) through the *5ESS*® switch module by switching multiple rates of 64 Kbps (NxDS0). Fractional DS1 Switching will expand the environments for calls between the following:

- SM-2000 to SM
- SM-2000 to SM-2000
- ORM to SM-2000
- SM to EXM

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- EXM to SM-2000
- ORM to EXM

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15.2 ISLU/PSU

15.2.1 ISLU

The ISLU contains the *5ESS*® switch BRI/DSL circuits (U or T BRI/DSL cards). The ISLU also provides a segregating function, sending B-channel, circuit-switched voice and data calls toward the time slot interchanger (TSI) and D-channel and (X.25) packet-switched B-channel calls toward the PSU, the PSU forms a packet switch network within the *5ESS*® switch. The DPIDBs (between the ISLUs and the PSU) thus perform a function similar to the PIDBs, providing access to an internal network from the periphery.

This is a key element of ISDN architecture: the creation of a separate packet-switched network paralleling the already existing circuit-switched time division network. This architecture confines the two types of calling, circuit and packet, with their differing call characteristics, to separate switch resources to meet the differing call requirements.

It is the same concept, however, of differing call types using unique resources in the switch and gaining access to the switch through a single interface (the BRI/DSL) that has profound impact on the assignment process.

The integrated services line unit (ISLU) supports the U- and the T-basic rate interfaces (BRIs) used for digital services between the end customer and the network. (Figure 15.2-1 .) The ISLU is also capable of supporting an analog line interface, the Z interface card, or Z-card. The Z-card is a per line coder/decoder (CODEC) and is not an ISDN interface; however, it can be mixed in ISLUs with BRI/DSL cards installed and must, therefore, be accommodated in the BRI/DSL assignment process. In terms of resource use, Z-cards create circuit-switched demand and must share common resources with ISDN circuit-switched calls.

Automated facilities are available to assist in the assignment and administration of ISDN equipment and lines.

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Figure 15.2-1 Integrated Services Line Unit Basic Diagram

The ability to mix the three types of cards in a single ISLU requires attention to the card type available/installed as an assignment parameter. The wiring of the circuit pack drawers in the ISLU is also a consideration. The T-card requires a 4-wire drawer, while the U- and Z-cards can be used in 2-wire or 4-wire drawers, but require the installation of high-level service circuit (HLSC) cards.

The ISLU has a capacity of 512 BRI/DSL cards arranged in line groups of 32 cards each. Each line group has its own controller or line group controller (LGC). The quantity of LGCs are engineered based on physical card quantities, circuit-switched traffic, or packet-switched traffic, whichever is determined to be limiting.

The output of the ISLU toward the *5ESS*® switch networks (packet and circuit) is a maximum of 24 data buses. Two separate quantities are engineered: PIDBs carrying circuit-switched voice and data calls to the time slot interchange and the time division circuit network, and DPIDBs carrying packet-switched calls to the packet switch unit (PSU) and its packet network.

Engineering of (circuit-switched) PIDBs follows existing methodologies that are based on expected traffic (CCS) on the BRI/DSL and Z-cards. For a fully equipped circuit-switched ISLU (512 cards installed), card concentration ratios varying from 2:1 to 16:1 are configured as shown in Table 15.2-1 .

Table 15.2-1 Fully Equipped ISLU Card Concentration Ratios

PIDBs	TS	LU EQUIV. CONCENTRATION	CCS HIGH DAY (30 min) CAPACITY
1	32	16:1	518
2	64	8:1	1,036

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3	96	5.3:1	1,555
4	128	4:1	2,073
5	160	3.2:1	2,592
6	192	2.6:1	3,110
7	224	2.3:1	3,628
8	256	2:1	4,147

Quantities of (packet-switched) DPIDBs are based on the number of BRI/DSL cards installed and the number of packet-switched B-channels configured on those cards. A fully equipped ISLU (512/496 BRI/DSL cards if spare cards are equipped) requires a minimum of 8 DPIDBs, leaving a maximum of 16 PIDBs for circuit-switched cards calling that supports the minimum concentration ratio noted previously.

The interfaces between the PIDBs/DPIDBs and the internal ISLU network are common data (CD) boards. Four are equipped and grouped into two service groups: each pair of CD boards functions as one entity from call processing and failure points of view.

The ISLU CD service groups can be configured as active/standby or active/active modes (RISLU supports only the active/standby mode.)

Active/standby mode provides duplex CD operation and therefore guarantees the preservation of stable calls if the active CD fails while the other CD is standby.

NOTE: The on-demand B-channel (ODB) call feature is supported only on the active/active configuration. This feature is not supported on RISLU.

Active/active (load sharing - ACTIVE MAJOR/ACTIVE MINOR) CD configuration, where both CDs are involved in call processing, provides greater call processing throughput and can be configured to carry the full traffic load of the ISLU without service degradation. The active/active configuration is not duplicable. This means that system reliability for the ISLU may be sacrificed when one of the CDs is taken out of service due to fault(s). Stable calls being served by the faulty CD are dropped but can be reestablished immediately.

The internal network of the ISLU is composed of data buses of the same structure (32 time slots each 16 bits wide) as the PIDB/DPIDB outputs. The time slot paths of the internal network is used for either circuit-switched or packet-switched calls.

Circuit-switched time slot paths are hunted at the initiation of a call. Packet-switched paths, however, are established whenever a BRI/DSL card is initialized (at unit installation or service order input). At that time, parallel paths are secured on each data bus (see Figure 15.2-1) to the PSU. Thus, there is a permanent, fully duplicated connection established from each BRI/DSL to the *5ESS*® switch packet network.

The impact of the differing mechanisms of path hunt and initialization requires detail discussion of the internal ISLU network, specifically the line interface data bus (LIDB) output paths (time slots) from the LGCs. Of the 64 time slots leaving each LGC on the 2 LIDBs, 2 (duplicated, for a total of 4) are dedicated to LGC and line card control. From a line group fully equipped with 32 BRI/DSL cards, an additional 16 time slots are needed for D-channels: four D-channels per time slot, duplicated. There are 44 time slots remaining to carry B-channel traffic. Each LIDB has a potential 1,584 CCS on the 44 TS (36 □ 44) = 1,584. Since the LIDBs are engineered at 40.9 percent occupancy, the engineered CCS capacity of the LIDB pair is 1,584 □ 0.409 = 648 CCS/LIDB pair. The importance of this use of time slots from the LGC requires consideration of the permitted B-channel configurations supported (see Table 15.2-2). Traffic sensitivity at the LGC (that is, concentration) may be present if the cards configured in an LGC offer more than 44 circuit-switched channels to the LIDB, as well as the number of PPBs assigned.

Table 15.2-2 2B+D Configurations

SOFTWARE 2B+D CONFIGURATIONS (NOTES 1 THROUGH 4)			
D SERV	**B1 SERV**	**B2 SERV**	**NOTES**
SX	DMD	DMD	PD, CKT AND PKT ON B-CHANNELS
SX	X.25	DMD	PD AND PPB, CKT AND PKT ON B2
SX	DMD	X.25	PD AND PPB2, CKT AND PKT ON B1

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SX	X.25	X.25	PD PPB1 AND PPB2, NO CKT
ADMIN	X.25	X.25	PPB1 AND PPB2, NO CKT, NO PD
ADMIN	-	X.25	PPB2, NO CKT, NO PD
ADMIN	X.25	-	PPB1, NO CKT, NO PD
XMP	-	-	MODEM POOL, PD ONLY, NO CKT
SONLY	DMD	-	ISDN ATTENDANT ONLY

Notes:

a. PD Packet-switch data on D-channel

b. CKT Voice and circuit-switch data

c. PKT Packet-switch data not nailed up

d. PPB[1,2] Packet-switch data nailed up on B1 or B2 channels

Even in the presence of concentration, recommended engineering methods (which limit average LIDB occupancy to around 40 percent) greatly lessen the traffic impact. (For comparison, it takes almost 70 percent occupancy to cause 1 percent blocking on a group of 44 servers.) Even though the impact is lessened, however, the necessity remains to distribute evenly BRI/DSL card configurations across line groups to match the average occupancy assumptions used in engineering.

A complicating factor in assessing the traffic impact at the LGC is the B-channel (X.25) packet switching configurations. Such channels are also provided with duplicated paths to the PSU at card initialization. Time slots for circuit-switching may, thus, be further reduced at the rate of two per packet-switched B-channel. (As the pool of time slots available for circuit-switching is reduced, the occupancy level at which a given level of blocking occurs also falls.) See Table 15.2-3 for PPB assignment vs. LIDB CCS.

Table 15.2-3 PPB Assignment Vs. LIDB CCS

NUMBER OF CIRCUITS	TSS REQUIRED	TSS USABLE	LIDB CCS CAPACITY
0	0	44	648
1	2	42	613
2	4	40	577
3	6	38	542
4	8	36	506
5	10	34	471
6	12	32	435
7	14	30	400
8	16	28	364
9	18	26	329

The Z-cards compete for the remaining time slots for circuit-switching. Configuration distribution should include Z-cards also. (Z-cards do not require paths to the PSU.)

15.2.1.1 ISLU2

The ISLU2, which is initially available in the 5E10 software release, is a replacement for the ISLU. This unit incorporates physical design changes and an increase in the number of BRI/DSLs supported on one unit.

The ISLU2 can support a current maximum of 768 lines. In the ISLU2, the line circuits are partitioned into 16 line groups with up to 64 lines in each group, as compared to the 32 lines per line group maximum on the ISLU. In the ISLU2, all line group circuitry is contained on circuit packs that are equipped in shelves. The ISLU2 can be configured as either a three-shelf, four-shelf, or five-shelf unit. As a three-shelf unit, ISLU2 consists of a common shelf, and either one line shelf and a plenum, or two line shelves. As a four shelf unit, ISLU2 consists of a common shelf and three line shelves. As a five-shelf unit, ISLU2 consists of a common shelf and four line shelves. These shelves eliminate the drawer hardware, and smaller KCB, and KCD packs used in the ISLU. In the present design, eight line circuits are contained on each pack. Line Group Control (LGC), and Line Group Power (LGP) functionality are distributed across the associated Line Packs (LP). There are no separate LGC and LGP packs.

In the ISLU2, the line circuits are partitioned into 16 line groups, with up to 64 lines in each group. Each line circuit is identified by a unique line-group, line-pack, and line-circuit designation. All eight line circuits

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equipped on a line pack are of the same type such as U, or T. Up to eight line packs of any type may be equipped in a line group in any combination. Since lines are equipped eight lines per pack, hardware growth and conversion must be done in groups of eight.

The ISLU2 data handling architecture is generally equivalent to that of the ISLU. The only difference is the electrical configuration of the LIDB interface used in the ISLU2 as compared to the LIDB interface in the ISLU. (See Figures 15.2-2 and 15.2-3 .)

Figure 15.2-2 ISLU2 Pack Configuration

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Figure 15.2-3 ISLU2 Shelf Configuration

15.2.1.1.1 Feature Descriptions

The ISLU2 is a unit available with, and requiring, the 5E10 software release. It is provisioned on either an SM, or an SM-2000. To understand the impact of ISLU2, the following describes what engineering changes are made by ISLU2, as well as what major engineering components have remained the same. Note that even though the ISLU2 is physically capable of supporting 1024 BRI/DSLs, the 5E10 software release currently only supports an engineering limit of 768 BRIs per unit.

The major engineering change with the ISLU2 is the capability to provide up to 768 BRIs per ISLU2 (when equipped with four line shelves) vs. the ISLU's maximum capacity of 512 BRIs. Because of the larger number of BRIs, an SM-2000 can support up to 3840 BRIs (5 ISLU2s x 768 BRIs per ISLU2). The limit of the SM remains at five ISLUs equipped with 512 BRIs each, or 5 ISLU2s equipped with only 512 BRIs each (real time limit), or three ISLU2s at 768 BRIs each (LTP physical limit). Due to the limitation of 768 BRIs, ISLU2 equipped boards are numbered zero through five. However, it is possible that other items could limit the SM before the above ISLU/ISLU2 limits are reached. Therefore, CCS and real time engineering must be performed for ISDN configurations. Equip boards zero through five for the U.S. market due to this limitation.

To accomplish the increased number of BRIs, new ISLU2 BRI cards are used which provide eight BRIs per card. These cards are available for the "U" and "T" interface. Analog "Z" cards are not supported in the ISLU2 for the 5E10 software release. As a result of the increase to 768 BRIs per ISLU2, and the fact that the maximum quantity of Line Group Controllers (LGC) per ISLU2 remain at 16, an ISLU2 LGC can support up to 48 BRIs. (In the ISLU2, the LGC is built into the Line Card and Line shelf, and the LGC functionality can be referred to as a "virtual LGC"). As a result, the Line Interface Data Bus (LIDB) CCS capacity is reduced to 506 CCS per LIDB pair (for a fully loaded ISLU2), or approximately 10.5 CCS per BRI.

15.2.1.1.2 LIDB TIMESLOTS

The method for calculating available LIDB time slots for a 768 BRI ISLU2 is as follows:

- 64 LIDB TSs per LGC - 24 TSs for D channels - 4 TSs for control = 36 TSs
- Subtract 2 time slots for each Permanent Packet B user provisioned in the Line Group to determine the remaining LIDB time slots available for circuit switched and On- Demand B (ODB) services.

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This method is also valid for calculating ISLU timeslots as well. Use Table 15.2-4 to determine the available LIDB CCS capacity for circuit switched and ODB services:

Table 15.2-4 LIDB CCS Capacity

REMAINING TS	CCS CAPACITY
10	45
12	80
14	116
16	151
18	187
20	222
22	258
24	293
26	329
28	364
30	400
32	435
34	471
36	506
38	542
40	577
42	613
44	648

If the ISLU2 is deloaded to accommodate higher CCS rates, the above LIDB capacity formula is adjusted as follows:

- 64 LIDB TSs per LGC - ((# of BRIs per LGC * .25) * 2) -4 TSs for control - (2 * PPB users per LGC) = X TSs
- Table look-up for X TSs = Available LIDB CCS Capacity

Note that the LIDB capacity reduction (due to provisioning of PPB) is changed from the previous value of 72 CCS. The change is caused by the results of simulations done to measure the actual impact of PPB on LIDB capacity).

As with the ISLU, there are 24 ports available on the Common Data Boards. An ISLU2 fully equipped with 1024 BRIs requires 6 active DPIDBs and 6 standby DPIDBs (1024 BRIs 25 TSs per BRI / 32 TSs per DPIDB). Therefore, 12 CD ports are required for DPIDBs, leaving 12 CD ports available for PIDBs. A fully equipped ISLU2, therefore, supports an average BRI CCS of 8.1 CCS. (6 active PIDBs * 1036.8 CCS per PIDB / 1024 BRIs = 8.1 CCS per BRI).

Table 15.2-5 X.25 B Channels Including ODB

NO. OF X.25 ASSIGNMENTS	LIDB TSs REQUIRED FOR X.25	LIDB TSs LEFT AVAIL. FOR CS	CS CCS AVAIL. (30 MIN.)
0	0	44	324.0
1	2	42	309.0
2	4	40	294.5
3	6	38	280.0
4	8	36	265.0
5	10	34	250.5
6	12	32	235.5
7	14	30	221.0
8	16	28	206.0
9	18	26	191.5
10	20	24	176.5
11	22	22	162.0
12	24	20	147.5
13	26	18	132.5
14	28	16	117.5
15	30	14	103.0
16	32	12	88.5
17	34	10	73.5

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18	36	8	59.0
19	38	6	44.0
20	40	4	29.5

The major ISLU2 engineering rules which have not changed are as follows:

- Common Data Boards ports = 24
- PIDB range per ISLU2 = 4 to 16 PIDBs
- DPIDB range = 2 to 20 DPIDBs
- PIDBs + DPIDBs <= 24
- There are 16 (virtual) LGCs per ISLU2
- PIDBs are engineered at 90% occupancy, then duplicated.
- An SM-2000 can support 5 ISLU2s with 768 BRIs each
- An SM can support 5 ISLU2s with 512 BRIs each (real time limit). Actual configurations may support fewer BRIs based upon actual real time and CCS engineering.
- An SM can only support 3 ISLU2s with more than 512 BRIs each (i.e. 768 BRIs) due to LTP cabinet limitations.
- MAN packs (without Line Circuit Sparing) = 2 if U-BRIs are present, else 0 if all T-BRIs
- MAN packs (with Line Circuit Sparing) = 2 - 4 if U-BRIs are present. Spare line equipment in LG00-LP00-LC00 and LG08-LP00-LC00, are supported by MAN Packs 00, and 01. If spare line equipment is assigned to LG07-LP03-LC00, MAN10 is required. If a spare assignment is made to position LG15-LP03-LC00, MAN11 is required (Where LG = Line Group, LP = Line Pack, and LC = Line Circuit). However, MAN Service Group 0 packs must be equipped prior to the MAN Service Group 1 packs. (for example, MAN00 must be equipped before MAN10, and MAN01 must be equipped before MAN11). T-BRIs cannot be spared.
- HLSC packs = 2 if U-BRIs are present, else 0 if all T- BRIs

15.2.1.1.3 Hardware

15.2.1.1.3.1 ISLU2 High Level Summary of Hardware Capabilities

- Available on both the SM and SM-2000 operating on the 5E10 software release.
- Uses new BRI packs which support 8 BRIs per pack. The new pack is available for U-BRIs and T-BRIs. The Z interface will not be supported with the 5E10 software release.
- Has 768 BRIs per ISLU2 terminal capacity in software release 5E10.
- 48 BRIs can be assigned to each virtual Line Group Controller
- Equipping an ISLU2 with 1024 BRIs requires 5 LTP equipment shelves.
- Equipping an ISLU or ISLU2 with 512 BRIs requires 3 LTP shelves.
- Same PICB and PIDB layout as ISLU.
- Provides 16 virtual Line Group Controllers per ISLU2. The Line Group Controller function (in the ISLU2) is incorporated in the Line Shelf and Line Card. Therefore, no LGC hardware engineering is

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required.

- Common Data boards have a 24 port capacity. Therefore, the PIDBs + DPIDBs <= 24.
- Mapping of LIDB D-channel time slots onto DPIDBs is the same as the ISLU mapping. Only four time slots on a particular DPIDB can be mapped to a particular LGC. Line Groups 0-7 can access DPIDBs A,C,E,G,I. Line groups 8-15 can access DPIDBs B,D,F,H,J.

15.2.1.1.4 Software

15.2.1.1.4.1 Line Circuit Naming

A new line circuit naming convention is required for the ISLU2. With the ISLU, each BRI is associated with a particular line card. For port naming, the Line Card Equipment Number (LCEN) is used. With the ISLU2, 8 BRIs are provided with each line card. Therefore, to identify the single line termination on the 8 BRI pack, Line Circuit Equipment Number (LCKEN) was created. The arguments for the LCEN (for ISLU) and the LCKEN (for ISLU2) are shown below:

LCEN = AAAHDDJJ

Where:

AAA = (1-192) Range for SM Number

H = (0-7) Range for ISLU Unit Number

DD = (00-15) Range for Line Group Controller Number

JJ = (00-31) Range for Line Card Number

LCKEN = AAABBDDEGG

Where:

AAA = (1-192) Range for SM or SM-2000 Number

BB = (00-42) Range for ISLU Unit Number

DD = (00-15) Range for Line Group Controller Number

E = (0-7) Range for Line Pack Number

GG = (00-07) Range for Line Circuit Number

Operations Systems will need to evaluate the impact

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of LCKEN on the systems, and modify them accordingly.

15.2.1.1.4.2 Real Time

The ISLU2 in itself will not impact SM-2000 real time. However, ISDN real time must be included when calculating total SM-2000 real time usage.

15.2.1.1.4.3 Administration

Two new administration considerations required are new LC naming conventions for the ISLU2, and the LIDB CCS capacity determination.

15.2.1.2 Multipoint Basic Rate Interface

This feature provides support for connecting a maximum of eight users, belonging to the same customer, to a single BRI. The feature makes it possible to alert one or more of the users connected to the same BRI. (Except for key system users, only one user will be alerted per call.)

There can be a maximum of eight terminal endpoint identifiers (TEIs) on a single BRI. The users share the two B-channels for circuit or packet mode services and the D-channel for signaling and additional packet data services. (A maximum of eight permanent D-channel links may be used for X.25 packet mode services.)

15.2.1.2.1 User Service Order Profile

The multipoint BRI service allows up to eight users per ``U-interface'' BRI or ``T-interface'' BRI. In either case, all users vie for the two B-channels of the 2B+D interface and share the D-channel for signaling and X.25 packet switching. Each user is allowed circuit-switched voice, circuit-switched data and X.25 packet-switched calls on either or both B-channels (B1 and B2). One user ``owns'' the B-channel during a call and the other users are excluded. The other users (or any other party) can be added to the call by invoking the multiway calling feature such as 3-way or 6-way conferencing. No special dialing is required between users on the same BRI.

In addition to each user call being private, its service configurations and feature subscriptions are independent. A separate user service order profile (USOP) containing the directory number, service configuration, billing directory number, and feature information, is stored for each user. This independence of user information from BRI data aids the implementation of the automatic customer station rearrangement feature, allowing the subscriber to make station moves without accessing a recent change terminal.

The service profile identifier (SPID) is the access key for all of the user service order information stored in a collection of data relations referred to as a USOP. Because BRI parameters are stored separately from the USOP, the user's service is activated when the USOP is bound to the BRI. After the binding process is completed the SPID becomes the key to all customer information. The *5ESS*® switch maps the information elements of the Q.931 and the LAPD protocols into the SPID to access the data required to service all of the user's calling requests.

A separate service order is required for each user subscription. From the user service order data, the *5ESS*® switch calculates and stores a customer identification called a Service Profile ID having three attributes:

(1) ***Extended Primary Directory Number (EPDN)*** - The DN or MLHG terminal number associated with the user service subscription.

(2) ***Network Access Type (NATYPE)*** - Attribute identifying whether the EPDN is a DN or MLHG

(3) ***Numbering Plan ID (NPID)*** - Identifies whether the EPDN is a circuit or packet numbering plan DN is a circuit or a packet MLHG.

The SPID for a standard line consists of two parts: (1) a 1 to 18-digit user service order profile identifier (USPID), and (2) a 2-digit terminal identifier (TID). The custom line consists of a 1 to 10-digit USPID only.

15.2.1.2.2 Signaling Interface

The multipoint service requires that the switch support independent signaling interfaces for up to 8 users per D-channel. The frame addressing the LAPD implements multiple logical links for each user on the D-channel. The individual users are identified by the terminal endpoint identifier (TEI). Each user is assigned a separate TEI, with TEI 127 used for broadcast to all users. Three service access point identifiers (SAPI) are reserved. The SAPI 0 is used for Q.931 signaling, and SAPI 16 is used for X.25 frames. The SAPI 63 is reserved for maintenance functions. A particular customer premises equipment (CPE) terminal can determine if a frame is intended for that CPE by examining the TEI and can tell if the frame is a call processing frame by the SAPI. Broadcast frames require the CPE to further examine the embedded information (Q.931 packet) to determine the appropriate response, if any.

The number of call processing logical links per PH has been increased from 256 to 384 to support MPT. Each user can have one logical link for circuit switching and another for packet switching, with users subscribing to D-channel packet switching only being required to have both a packet and a signaling link.

15.2.1.2.3 Call Processing Impacts

The Multipoint BRI service requires that the CPE be able to identify itself to the switch. This is accomplished through the end point identification (EPID) procedures. The EPID procedures are implemented in new information elements of the set up message and new parameters in the management information message. The MPT compatible CPE is required to perform additional packet processing to determine the SPID or DN contained in the Q.931 packet. Individual Multipoint CPE only acknowledges packets containing its own SPID or DN.

15.2.1.2.4 Operations

There are no new TRFC30 counts for Multipoint service. Engineering and daily administration use existing ISDN usage and peg count measurements.

Several maintenance enhancements have been added for Multipoint service. The craftsperson must have the ability to remove and restore, perform digital tests, and receive protocol error notification for individual CPE. Craftsperson must also be able to obtain CPE status including the SPID, terminal initialization type, and TEI.

15.2.1.3 Automatic Customer Station Rearrangement

The ISDN Automatic Customer Station Rearrangement enables end-users to relocate their terminal equipment and associated directory number, without a service order. The customer dials an access code and the recent change is completed by the switch.

15.2.1.4 Customer Perspective

The internal packet network of the *5ESS*® switch is provided by the PSU (shown in Figure 15.2-4).

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Figure 15.2-4 Packet Switch Unit

Data frames containing X.25 protocol packets or Q.931 protocol packets arrive at the unit over DPIDBs from BRIs in the ISLUs; Lucent Technologies proprietary internal protocol (IP) frames arrive over PIDBs from the TSI for ISM and interswitch packet calls. All are switched to PH data buses (PHDBs) by a data fanout (DF). A DF functions as a full time slot interchanger, switching between any two PIDB/DPIDB and PHDB time slots. A duplicated DF is provided for each PSU shelf. It is important to note that the time slot switching is done with whole time slots.

The primary component in the *5ESS*® switch packet network is the protocol handler (PH), which performs all layer 2 and X.25 layer 3 protocol processing. A maximum of 16 PHs can be equipped on a single PSU shelf. The quantity of PHs required is a function of BRI cards installed or data throughput requirements, whichever is limiting. The PHs are not duplicated, but are provisioned using an 'n + k' sparing scheme, where 'k', the number of spare PHs, is established by the service provider and 'n' is the number of PHs not including spares. The range of spares per shelf is from zero to eight, for an effective duplication of PHs if desired (Lucent recommends 1 spare per shelf). Table 15.2-6 illustrates the relative throughput of the PHs versus the various software releases.

The PHs are functionally distinguished as five types. (These distinctions are to facilitate PH engineering and administration. In terms of software and firmware, all PHs are identical and interchangeable.)

- ***Access PH*** - Serves B, ODB, D X.25 and D-channel signaling
- ***ISM*** - The inter-SM (ISM) PHs process IP frames for packet calls between SMs.
- ***ISPT*** - The inter-SM packet trunk (ISPT) PHs handle packet data to other switches or networks via an external (to the *5ESS* ® switch) packet tandem switch [the Lucent Technologies *Western Electric*® Packet Switching System (1PSS)].
- ***IP*** - Internal Protocol *5ESS*® switch to *5ESS*® switch)

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- ***PRI*** - Primary Rate Interface.

Table 15.2-6 Protocol Handler Throughput

PH	ACCESS	INTER-SM (ISM)			INTER-SW (ISPT)		X.75/x.75´ INTER-SW	
	PPS	PPS	TSs	MODE	PPS	TSs	PPS	TSs
PH2	50	96	3	NON-ACK	40	1	40	1
		64	2	ACK				
PH3/PH4	200	320	10	NON-ACK	240	6	200	4
		192	6	ACK				

Packets are transmitted between PHs through the (duplicated) packet fanout (PF) provided, per PSU shelf, and over the packet bus using the IP.

Data communication between the shelves of the PSU, as well as the distribution of control messages to the fanouts and PHs, is performed by the duplicated control fanout (CF), provided one per unit. The CF also transmits and receives data frames and control messages between the PSU and the switching module processor (SMP) over the packet bus (PB) and peripheral interface control bus (PICB), respectively. The CF acts as the arbiter for the broadcast of data and control information over the internal PF data network between PHs (and the SMP).

The PSU provides full local area network (LAN) functionality for BRIs existing in a single SM or in an ISM network. Layer 2 protocol processing [link access protocol, type B for packet-switched B-channels (LAPB) and type D for D-channels (LAPD)] and X.25 layer 3 protocol processing is performed autonomously by the access PHs for packet-switched calls. The SMP is used for routing information at virtual call set up time.

The PH terminates only layer 2 protocol (LAPD) for the Q.931 packets associated with circuit-switched calls. These packets are forwarded to the SMP for layer 3 termination.

From an assignment point of view, it is significant that the architecture assigns functions to discrete resources (PHs). To achieve the engineered capacity of the ISLU, it is necessary to administer the load on the packet network in the *5ESS*® switch in a manner analogous to the circuit-switched load. A difference exists between the packet- and circuit-switched networks in that the packet network is nonblocking. Instead, the end-user experiences poorer performance during overload conditions. These performance degradations are usually manifested in longer file transfer times and 'real-time breaks' during display functions. In short, a congested packet network performs similarly to an overloaded processor in a time-shared computer system.

To ensure good packet switching service, it is necessary to evenly distribute the packet load across the PHs in the PSU. This requires that the lines be categorized according to anticipated packet load. This load may be based on traffic measurements, but is initially derived from service attributes or knowledge of specific customer applications.

Note, however, that packet load analysis depends less on BRI configurations, as in the ISLU case, and more on applications, which may vary widely. There are several factors germane to this analysis.

A common application is terminal to host computer communications. These tend to be low usage, in terms of packet throughput, with response time limited by the host computer and not the network. Typical examples are electronic mail and text processing.

Applications that involve LANs and data entry/data collection networks experience higher packet loads. These are high-speed transmission networks, and often involve some sort of distributed processing. These applications could involve order entry, record updates, and point-of-sale terminals.

The highest usage applications involve host-computer to host-computer communications. Typical applications could include program downloading and remote job entry functions.

Packet load and, hence, resource demand is affected by packet size, also. Packet size refers to the

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amount of data (in bytes) that is transmitted in a single packet. This parameter in the construction of the individual packets is controlled by the customer premises equipment (CPE). The impact can be summarized in saying that, for a given bit rate and channel occupancy, the smaller the packet, the greater the packets per second transmitted.

For example, a 9.6 kilobit per second (Kbps) line operating at 85 percent occupancy transmits 8,160 bits of data in 1 second. With a packet size of 128-bytes, roughly eight data packets per second (dpps) is transmitted. If the packet size is halved, to 64 bytes, the data rate, in dpps, doubles to 16. Considering that an access PH has a packet load capacity of 50 dpps, the effect on BRI assignment is obvious.

The full impact of the data rate/packet size relationship is expected only during large file transfer operations where a link carries sustained transmission. If an individual link does exceed the PH overload control threshold, the PH returns a 'receiver not ready' message, resulting in the CPE experiencing a longer time to complete the file transfer. There is no data corrupted or lost, and the switch does not peg any error registers due to this type of packet overload.

In the analysis of packet switching loads, the influence of BRI configuration is not totally absent, however. The major difference between packet switching on the B- and D-channels is the bandwidth of the transmission: the B-channel is a 64 Kbps channel and the D-channel is a 16 Kbps channel. (A second difference is the maximum number of virtual calls per channel: 15 for the B-channel and 127 for the D-channel.

The impact of this is found in the number of time slots required to carry packet calls from the line group controller in the ISLU to the PH. Because a time slot and a B-channel both have a 64 Kbps bandwidth, a B-channel requires a whole time slot. The D-channels, however, can be multiplexed (up to four per time slot).

The number of time slots between ISLUs and the PSU dedicated for packet traffic is an engineered quantity. The switch assigns them at initialization or service order entry based on assignment input (BRI card and PH). The impact on the assignment process is that unless the engineered utilization is achieved, either line card terminations or PH capacity is lost.

15.2.2 PSU2

The PSU2 is initially available in the 5E10 software release. This unit is a replacement for the PSU. It provides a centralized high bandwidth interface that supports packet switching of data and signaling messages on both the SM-2000 and SM platforms. The PSU2 provides the ability to support the D-Channel Signaling associated with the *5ESS*® switch ISDN services, in addition to the ability to switch customer packet data on the B- or D-Channels.

15.2.2.1 Hardware

The PSU2 hardware platform consists of a new 5 shelf, 100 Mb/s backplane PSU2 unit equipped with new Control Fanout 2 (CF2), Packet Fanout 2 (PF2), and Protocol Handler 4 (PH4) circuit packs. The PSU2 also supports the Data Fanout (DF) interface which supports a maximum of 6 DPIDBs and 1 PIDB per shelf, or the Data Fanout Multiple PIDB (DFMP)interface which supports up to 4 PIDBs per shelf. The PSU2 will interface with the SM-2000's or SM's Module Controller and Time Slot Interchange Unit (MCTU) through the new Packet Interface 2 (PI2). The PI2 provides significantly higher packet throughput [800 packets per second (pkts/sec) versus 210 (pkts/sec)].

The PSU2's packet switching interfaces are provided by the peripheral interface data buses (PIDBs) to the TSIU, and the directly connected peripheral interface data buses (DPIDBs) to the various peripheral units such as the ISLU2. The PSU2's communication with the SMP is via the peripheral interface control buses (PICBs) which provide a low level control interface, and via the packet bus (PB) which provides a high level control and signaling interface. The PSU2 also supports the Data Fanout (DF) interface which supports a maximum of 6 DPIDBs and 1 PIDB per shelf, or the Data Fanout Multiple PIDB (DFMP)interface which supports up to 4 PIDBs per shelf. The PSU2 will interface with the SM-2000's or SM's Module Controller

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and Time Slot Interchange Unit (MCTU) through the new Packet Interface 2 (PI2).

The Data Fanout terminates six DPIDBs and one PIDB to the active side (and the same on the standby side). The Data Fanout is required if any BRIs will be terminated to a particular PSU2 shelf. This unit is engineered the same as the current PSU.

The SIP feature (99-5E-8382) adds new hardware to the PSU2, including the SIP Protocol Handlers (PHs) and General Quad-Link Protocol Handlers (GQPHs), The new hardware components are described in detail in 235-200-118 *Session Initiation Protocol for Packet Trunking - OA&M Manual* .

15.2.2.2 Data Fanout Multiple PIDB Unit

The Data Fanout Multiple PIDB (DFMP) is a unit which provides 1-4 active PIDBs and 1-4 standby PIDBs to the active DI. No DPIDBs are supported. Therefore, at a minimum, each DFMP requires 2 PIDB ports to the active side and 2 PIDB ports to the standby side of the time slot interchange. At a maximum, each DFMP requires 8 PIDB ports to the active, and 8 PIDB ports to the standby side of the time slot interchange. In an SM-2000 application, a 5 shelf PSU2 fully equipped with DFMPs would require 40 PIDB terminations on the active DX and the same on the standby DX (SM-2000 has a 136 active side PIDBs available for optional peripherals). This configuration would not fit on an SM, since only 31 DI ports are available. The DFMP can be used for applications where there are concentrations of nail-up trunks (for example, IP, X.75, X.75',XAT, PRI) in one SM/SM-2000, and the use of the Data Fanout would limit the PSU2 shelf on PIDB time slots to the time slot interchange.

In 5E10 software release, both the SM, and SM-2000 will support the following peripherals: ISLU2, IDCU, DLTU2, and DLTU-RH. DNU-S is only supported on the SM-2000. The DLTU and ISLU are only supported on the SM.

The PSU2 occupies from one to five equipment shelves in a single cabinet and consists of the following circuitry (see Figure 15.2-5):

1. Data Fanout (DF)

- Terminates up to six DPIDBs and one PIDB
- Performs the time slot assignment of the DPIDBs and PIDB to the PH4s via the protocol handler data bus (PHDB)

2. Data Fanout with Multiple PIDBs (DFMP)

- Terminates up to four PIDBs
- Performs the time slot assignment of the PIDBs to the PH4s via the protocol handler data bus (PHDB)

3. Packet Fanout 2 (PF2)

- Distributes packet bus arbitration control signals to the PH4s
- Concentrates packet bus requests from the PH4s to the CF2
- Distributes packet bus data to the PH4s

4. Control Fanout 2 (CF2)

- Communicates with the SMP via a PICB
- Distributes configuration and control information to the PF2 and the DF or DFMP

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- Distributes time slot assignment information to the DF or DFMP
- Performs packet bus arbitration

5. Protocol Handler 4 (PH4)

- Communicates D-Channel information via time slots from the DF or DFMP
- Supports a maximum of 128 sixteen kb/s Channels or 32 sixty-four kb/s Channels
- Communicates over the packet bus to the SMP and to other PH4s
- Provides a localized environment to support distributed processing

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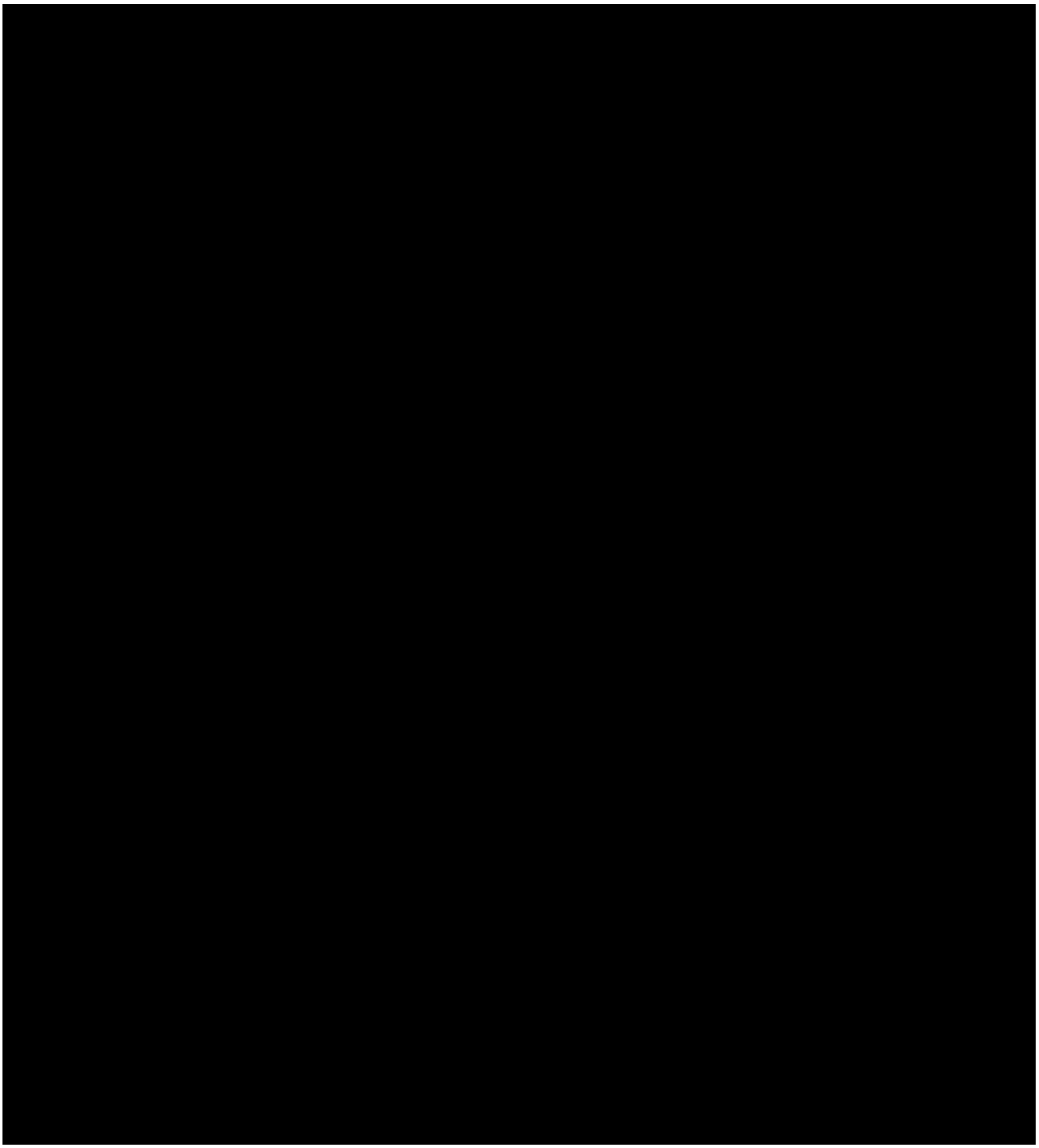

Figure 15.2-5 5 Shelf PSU2 Unit

15.2.2.3 PSU/PSU2 Engineering

Engineering of the PSU/PSU2 commences with the assignment of equipment to a specific SM/SM-2000 that impacts the PSU/PSU2. The following is a list of equipment that impacts the resources of the PSU/PSU2:

- ISLU/ISLU2
- IDCU [e/w TR-303 and/or (TR-303 and TR-008)]

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- AIU (e/w 2B+D lines)
- EAIU/XAIU
- DNU-S e/w TR-303 RDT
- Packet Trunks (X.75, X.75', XAT, and/or IP)
- PRI (Custom and/or Standard)
- PHs
- DFMP and/ or DF2 assigned to accommodate Nail-Ups (NUs).

15.2.2.3.1 Resources of the PSU/PSU2

To ascertain what resources have been assigned and, subsequently, determine what resources are still available for assignment, it is necessary to know the attributes of the PSU/PSU2. The following is a description of the resources available:

- A maximum of five (5) shelves
- Each shelf has a capability to terminate six (6) DPIDB and thirty two (32) NUs
- Each shelf that is assigned a DFMP (a.k.a. MPDF) may terminate a maximum of one hundred and twenty eight (128) NUs, but no DPIDBs
- Each shelf that is assigned a DF2 (a.k.a. OPDF) may terminate a maximum of four hundred and eighty (480) NUs, but no DPIDBs

  Note 1: For planning purposes, the OPDF will satisfy all Nail-Ups; currently, the OPDF will not support the following:

  - EAIU
  - PRI (Custom and/or Standard)
  - Packet Trunks.

  Note 2: Complete Utilization of available NU assignments provided by the MPDF and/or OPDF may not be possible (review the ISA report for existing PSU/PSU2 assignments).
- Each shelf is limited to sixteen (16) PHs (PH3 , PH4 and/or PH22) inclusive of spares
- With the 5E12 Software Release, an SM/SM-2000 is limited to a total of one hundred and twenty seven (127) NUs
- With the 5E13 Software Release, an SM/SM-2000 is limited to a total of six hundred and forty (640) NUs.

15.2.2.3.2 Resources Required by Equipment Type

As noted in the **PSU/PSU2 Engineering** Section, each assignment of equipment has a specific impact on the PSU/PSU2. The following is a description of the resource requirements specific to each individual equipment item:

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Note: In the calculation of PHs, identified below, only the terminal limitation is identified. If the Packet Per Second (PPS) for 2B+D lines is greater than the default value of 0.02, then the greater number of PHs for terminations or the number of PHs required for packet throughput applies. Use the following formula to calculate the PHs required for packet throughput:

(number of 2B+D lines *PPS)/capacity of the PH, rounded to an integer as appropriate.

- ISLU/ISLU2 and AIU (e/w 2B+D lines) - Impacts the number of DPIDBs and PHs:
  - DPIDB calculation: [(number of 2B+D lines/4 TSs)/ 32 TSs per DPIDB, rounded up to an integer + PPB/32 TSs, rounded up to an integer]
  - PH calculation: number of 2B+D lines/128, rounded up to an integer + (number of PPB * PPS)/capacity of the specific PH deployed, rounded up to an integer + spares per shelf

    Note: PPB Assignment Limits: ISLU2 - 64; AIU - 16 (per EAIU cabinet).

- IDCU (e/w TR303 RTs) - Impacts the number of DPIDBs and PHs:
  - DPIDB calculation: [4 control TS * number of RTs + (number of 2B+D lines/4 TSs)/ 32 TSs per DPIDB], rounded up to an integer + PPB on all RTs/32 TSs, rounded up to an integer
  - PH calculation: total number of 2B+D lines/128 + (.125* number of RTs), rounded up to an integer + (number of PPB * PPS)/capacity of the specific PH deployed, rounded up to an integer + spares per shelf

    NOTE: **The .125 is for the EOC & TMC requirements and is derived by dividing the four (4) TS per PH.**

- EAIU/XAIU - Impacts the number of NUs and PHs:
  - NU calculation: number of 2B+D lines/4, rounded up to an integer + PPB channels

    Note: PPB assignment limit is forty eight (48).
  - PH calculation: number of 2B+D lines/128, rounded up to an integer + (number of PPB * PPS)/capacity of the specific PH deployed, rounded up to integer

- DNU-S e/w TR303 RDT - Impacts the number of NUs and PHs:
  - NU calculation: [4 control TS * number of RDTs + (total number of 2B+D lines on all RDTs /4 TSs)] rounded up to an integer
  - PH calculation: total number of 2B+D lines/128 + 0.125 * all RDTs on the DNU-S, rounded to an integer + (total PPB on all RDTs * PPS)/capacity of the PH, rounded to an integer

- Packet Trunks (X.75, X.75', XAT, and/or IP) - Impacts the number of NUs and PHs:
  - NU calculation: 1 NU per trunk
  - PH calculation:
    - X.75 - 1 PH per 4 trunks
    - X.75 '- 1 PH per 4 trunks

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- XAT - 1 PH per 25 trunks
- IP - 1 PH per 6 trunks

- PRI (Custom and/or Standard) - Impacts the number of NUs and PHs:
  - NU calculation:
    - Custom - 1 NU per PRI with a maximum of 127 NUs in Software Release 5E12 per SM-2000 and 640 NUs in Software Release 5E13 and later
    - Standard - Minimum of 1 NU per Standard PRI group (each group is limited to a maximum of 20 DS1s) with a maximum of 127 NUs in Software Release 5E12 and 640 NUs in Software Release 5E13 and later
  - PH calculation:
    - Custom - 1 PH per 32 PRI
    - Standard - 1 PH per 32 D-channels; however, an additional PH is provisioned when the D-channel Backup feature is selected (1 PH per shelf e/w Standard PRI) for a maximum of 1000 DS1s per SM-2000

15.2.2.3.3 Enhancements

The purpose of features 97-CP-4246.G and 97-CP-4246.M, is to enhance the existing call processing software in order for an SS7 PSU to support the signaling needs of non-global SMs in the office. With the implementation of these features, the following enhancements take place:

(1) Integrated Services Digital Network User Part (ISUP) Enhancements

- 97-CP-4246.G (5E14)
  - - Handling of ISUP calls when CMT within Global Switch Module (GSM) is unavailable
  - Throttling of calls when a CCS Message Transport (CMT) overload for GSM is detected.
- 97-CP-4246.M (5E15)
  - - Switch Module (SM) (global and non-global) selection of CMT to Host GSM
  - Handling of ISUP calls when CMT to/from a Host GSM is unavailable
  - Throttling of calls when CMT overload is detected.

(2) Transaction Capabilities (TCAP) Enhancements

- 97-CP-4246.G (5E15)
  - Handling of TCAP queries when CMT is unavailable

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- Throttling of TCAP queries when CMT overload is detected
- Handling of TCAP queries when Host GSM is unavailable
- Throttling of TCAP queries when Host GSM is experiencing overload.

(3) Signaling Connection Control Point (SCCP) Enhancements

- 97-CP-4246.G (5E15)
  - New command, **OP:CCS,TPC**, to report the translation point codes for a specified translation type derived that has been provisioned in a GSM.

In summary, feature 97-CP-4246.G in the 5E15 Software Release, G allows an SS7 PSU on a Global SM to support the SS7 PSU signaling needs of non-global SMs. In addition, this feature enables the GSM to check CCS message transport path availability to the SS7 PSU and take appropriate action. Feature 99-CP-4246.M in the 5E15 Software Release, lifts the ISUP trunk group restriction for limiting members to the GSM. With the activation of feature 97-CP-4246.M, trunk members may be provisioned on any SM in the office and transmit/receive CCS messages to/from a host GSM as long as a CMT path is provisioned between the trunk member's SM and the host GSM.

15.2.2.3.4 Signaling and Protocol

The PSU2, PH4, and PI2 hardware units do not impact the following:

- Subscriber/Exchange Interfaces
- Exchange/Exchange Interfaces
- Other Intra-Network Interfaces

15.2.2.3.5 Session Initiation Protocol (SIP) Feature (99-5E-8382)

The SIP feature requires specific engineering guidelines and requirements. Refer to 235-200-118 *Session Initiation Protocol for Packet Trunking - OA&M Manual* for additional information on this feature.

15.2.2.3.5.1 Hardware Platform Considerations

- SIP requires a 5ESS switch office to be equipped with QLPS and SM-2000s.
- SIP is not supported on a DRM, EXM, CDX, VCDX, or Classic SM/RSM/ORM.
- SIP requires a PSU2 equipped with Data Fanout 2 (DF2).
- SIP can coexist on the same PSU2 shelf with other applications (i.e., SS7, ISDN, etc.).

15.2.2.3.5.2 SIP Protocol Handler (SIPPH) Engineering

The SIPPH is a new channel group that uses the PHE2 protocol handler. The PHE2 is a member of the PH30 family of protocol handlers.

The SIPPH engineering rules and guidelines are as follows:

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- The SIPPH channel group requires a PHE2 (TN13 with a LLE2 100 Base-T Ethernet Paddleboard).
- Previous PH versions (such as a PH22 or PH3) cannot be used to support SIP.
- Only a single 100 Base-T Ethernet connection on the PHE2 is supported for SIP.
- A PSU2 shelf equipped with PHE2s requires the Data Fanout 2 (DF2).
- For reliability, the SIPPH (PHE2) should be engineered as mated (serving/non-serving) pairs. This is also referred to as a Processor Group.
- Up to 16 SIPPHs (8 mated pairs) is currently supported per SM-2000.

The SIPPH is engineered based on call load as shown in Table 15.2-7 .

Table 15.2-7 SIPPH Engineering (Preliminary)

SIPPHs	SIP BHC Load							
	0-200K	200K-400K	400K-600K	600K-800K	800K-1M	1M-1.2M	1.2M-1.4M	1.4M-1.6M
Processor Groups	1	2	3	4	5	6	7	8
PHE2s (TN13) Packs	2	4	6	8	10	12	14	16
LLE2 Paddle Boards	2	4	6	8	10	12	14	16

15.2.2.3.5.3 General QLPS Protocol Handlers (GQPH) Engineering

The GQPH is a new channel group that will make use of the PH33, another member of the PH30 family of protocol handlers.

The GQPH engineering rules and guidelines are as follows:

- The GQPH channel group requires a PH33 (TN113 with no Paddleboard).
- Previous PH versions (such as a PH22 or PH3) cannot be used to support SIP.
- A PSU2 shelf equipped with PH33s requires the DF2.
- A minimum of 2 GQPHs are required.
- Each GQPH engineered requires 48 NCT2 TSs (24 TS pipe to each side of the QLPS).
- Up to 16 GQPHs can be equipped per SM-2000, which is dependent on the number of SS7 QPHs that may be sharing the same PSU2, therefore the sum total of QPHs and GQPHs may not exceed the software limit of 16 per SM-2000 (59 per office). In addition to this software limit, the maximum engineerable GQPHs/QPHs is also subject to the 256 timeslots available on the primary NLI for control/messaging. Of the 256 TS, 16 TSs are reserved for the CTSs and MH-QLPS Pipe, leaving 240 TSs available to be used by GQPHs and QPHs. For example, 10 GQPHs would require 10*24=240 TSs, which would not leave sufficient TSs to also support 6 QPHs. Considering that the current office capacity of 2M BHCs would only require a customer to engineer 2 GQPHs, this would leave sufficient TSs for up to 14 QPHs (2*24+14*12=216TSs) allowing a sum total of 16 GQPHs/QPHs.
- One standby spare GQPH (TN113) should be provided for each shelf equipped with GQPHs to support REX maintenance and software updates.

The GQPH engineering for Tandem and Local applications is shown in Table 15.2-8

Table 15.2-8 QGPH Engineering

GQPHs	Tandem Office	Local Office

(Does Not Include Any Standby Spares)		
PH33s (TN113) Packs	2	2

15.2.2.3.5.4 Pack Assignment Guidelines

- It is recommended to spread the PHs across separate fuse groups, power buses, and PSU2 shelves when possible for reliability.
- A separate power bus feeds each half of the PSU shelf.
- Each group of 4 PH slots on a given shelf share the same fuse.

15.2.2.3.5.5 Call Capacity

SIP call capacity is shown in Table 15.2-9

Table 15.2-9 SIP Call Capacity

Engineering Parameter	Capacity	
	Local Office	Tandem Office
Office Call Capacity (assuming CM3 and PSU based signaling)	1.6M BHC	2M BHC
SM-2000 Call Capacity (CORE60)	100K BHC	120K BHC

15.2.2.3.5.6 Engineering Limits

Current engineering limits are summarized in Table 15.2-10

Table 15.2-10 SIP Engineering Limits

Parameter	Capacity	Notes
SIP GSMs	4	Software limit
QPHs + GQPHs per GSM	16	Sum total of QPHs and GQPHs can not exceed 16
QPHs + GQPHs per Office	59	Software limit
DF2/NCT2 TSs per QPH	24	12 TS pipe to each QLPS side
DF2/NCT2 TSs per GQPH	48	24 TS pipe to each QLPS side
SIPPH (PHE2s) per GSM	16	The current grounding plate design supports up to 16 Ethernet links per PSU2
100 Base-T Ethernet Links per SIPPH	1	Software limit
SIPPHs per Processor Group	2	SIPPHs are provisioned either in pairs (Serving/Non-Serving) or as a single PH. When provisioned in pairs, the members of the pair can reside either on the same shelf or on different shelves in the same PSU.
SIPPH Processor Groups per GSM	8	Up to 8 PGs (16 total SIPPHs).
Near SCTP Endpoints per SIPPH Processor Group	1	Software limit
IP Addresses per Endpoint	2	Software limit
Far SCTP Endpoints per Office	1023	Software limit
Maximum Recommended Associations per SIPPH Processor Group	TBD	Each association consumes resources on the SIPPH. Engineering guidelines are currently under investigation and will be published when available.
Associations per Office	1023	Software limit
Associations per Association Set	64	Software limit
Association Sets per Packet Group	1	Software limit
Packet Groups per Office	1000	Software limit (Numbered 7000-7999)
Bearer Network IDs	512	Software limit

15.2.2.3.6 Hardware Interfaces

The Packet Switch Unit Unit 2 (PSU2) supports the following:

- 5 shelf 100 Mb/s backplane.
- Control Fanout 2 (CF2) circuit packs

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- Packet Fanout 2 (PF2) circuit packs
- Data Fanout (DF) circuit packs
- Data Fanout Multiple PIDB (DFMP) circuit packs

The PSU2 unit needs to support a mix of shelves which contain either the Data Fanout (DF) circuit packs or Data Fanout Multiple PIDBs (DFMPs) circuit packs. Each PSU2 shelf can support up to 16 Protocol Handler 4s (PH4s). PSU2 and PSU shelves support up to 16 Protocol Handler 4s (PH4s) beginning with the 5E10 software release.

15.2.2.3.7 Interactions and Transparencies with Other Features

The PSU2 supports interfacing with the ISLU2, IDCU, DLTU2, DLTU-RH, DNU-S, and PI2 on both SM-2000 and SMs. The packet switching services which are provided by the PSU2 on the SM-2000 or SM, must not experience any degradation in service to the end-user when compared to its associated packet switching service which is provided by the PSU on the SM.

15.2.2.3.8 Operations, Administration and Provisioning

The PSU2 and PI2 hardware does not affect the existing input/output messages and measurements. The input/output messages and measurements which currently reference the "PSU" will, therefore, be performed on either the "PSU2" or "PSU", which ever is present. This transparent input/output message and measurements approach will also be utilized for the PI2 and the PI.

15.2.2.3.9 Service Changes

RC/V must provide the ability to insert, update, and delete the PSU2 and PI2 hardware in support of the PSU2 feature on both the SM-2000 and SM. The PSU2 and PI2 hardware which must be supported includes the PSU2, CF2, PF2, DF or DFMP, PH4, and PI2. The Recent Change Views which may be impacted are as follows:

- RC_PSUPI 22V1
- RC_PSU 22V2
- VER_PSU 22V2
- RC_PSUSH 22V3
- RC_PSUPH 22V4

RC/V blocks the ability to provide the OSPS, ACD/BRCS, and DSN feature applications on the PSU2 and PI2 hardware platform on both the SM-2000 and SM. (The PSU2 and PI2 hardware platform includes the following hardware: PSU2, CF2, PF2, DF or DFMP, PH4, and PI2.) RC/V must support the following PH Conversion Procedures for the PHs in PSUs on SMs:

- PH3 to PH4
- PH2 to PH4
- PH4 to PH3
- PH4 to PH2

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RC/V must support the ability to add or delete a PIDB on a DFMP. When a PIDB is added to the DFMP, the PIDB circuit is placed in a out-of service state, and must be restored by the craft. A PIDB may only be deleted under the following conditions:

(1) The PIDB circuit status is out-of-service.

(2) Deleting the PIDB will not decrease the number of available PIDB time slots below the number of ISDN and CDMA applications assigned to the PSU2 shelf containing the PIDB.

15.2.2.3.9.1 Software Update

The software program update capabilities PI2 and PH4 respectively. The capabilities [for example: apply, back out, or back out last official (BOLO)] to update a PI2 and PH4 are provided as part of this feature.

15.2.2.3.10 Protocol Handler 2

The Protocol Handler 2 (PH2) is limited to 1 MB of memory. The PH2 currently supports the functions shown in Table 15.2-11 .

Table 15.2-11 PH2 Functions

5E6 - 5E8	5E9(1) and later	FUNCTION
Q.931	Q.931	Signaling
X.25	-	Packet Data
X.75/X.75'	X.75/X.75'	Packet trunk
IP	IP	
XAT	-	
ISM	ISM	Inter SM packet

15.2.2.3.11 Protocol Handler 3

The protocol handler 3 (PH3), has greater throughput and reduced time delay as compared to earlier PHs. See Table 15.2-6 for a direct comparison of PH throughput.

15.2.2.3.12 Protocol Handler 4

The PH4 is equivalent to a PH3, except that the amount of memory has been optimized for use with ISDN applications.

15.2.2.4 Directly Connected Peripheral Interface Data Buses

The ISLU is logically divided in half with each half having a unique set of DPIDBs that are designated, for purposes of discussion, alphabetically. The half ISLU relationship is established by an initialization algorithm implemented in the *5ESS*® switch software that nails up connections between LGCs and PHs using predetermined time slots. This algorithm guarantees that LGCs do not experience time-slot contention problems and results in a particular pattern of time slots on the DPIDBs.

The DPIDB time slot output of the ISLU is shown pictorially in Figure 15.2-6 . Note that ISLU half 0-7 (LGCs 0-7) can only be equipped with DPIDBs A, C, E, G, and I, and the other ISLU half 8-15 (LGCs 8-15) can only be equipped with DPIDBs B, D, F, H, and J. As a result of the initialization algorithm mentioned earlier, each LGC in the ISLU has access to four unique time slots on each DPIDB. Because an LGC has access to a total of 5 DPIDBs (that is, A, C, E, G, and I for LGCs 0-7), there is a maximum of 20 time slots per LGC to the PSU. The exact number of time slots available to a given LGC depends on the number of DPIDBs engineered from that ISLU half. These time slots are used for connecting both B-channels with X.25 packet switching and D-channels to the PSU.

NOTE: Recall that a time slot can carry up to four D-channels but only one B-channel.

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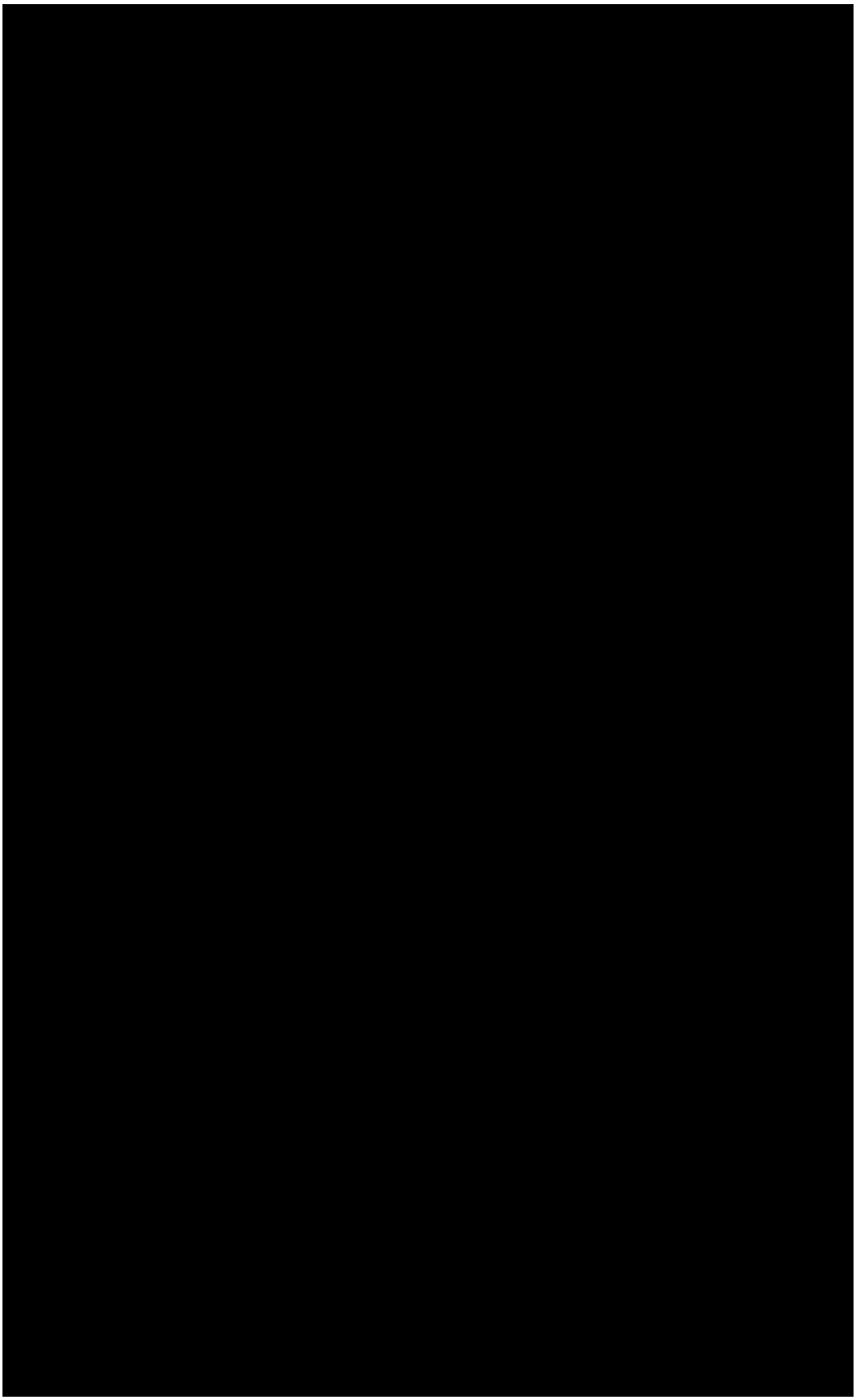

Figure 15.2-6 LGC LIDB Time Slots DPIDB Stuffing Pattern

The assignment implications of the DPIDB arrangement described previously are not immediately obvious.

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They are as follows:

- The BRI D-channels that share a DPIDB time slot must all terminate to the same PH.
- A BRI channel carried to the PSU in a DPIDB time slot may only be assigned to a PH on the PSU shelf where that DPIDB terminates.
- Depending on the ISLU to PSU cabling arrangement, BRIs in an ISLU half may not have access to all PHs (that is, PSU shelves).
- As DPIDB time slots are assigned, access to assignable PHs is reduced.
- Because a whole time slot is switched to a PH, and an LGC has only 4 time slots per DPIDB, an LGC can communicate with a maximum of 4 PHs per DPIDB.

Consider two examples: In Figure 15.2-7 , the ISLU half corresponding to LGCs 0-7 has no connection to PSU shelf 3. Therefore, no lines in that ISLU half can be assigned to PHs on PSU shelf 3. In Figure 15.2-8 , all BRI cards have access to all PHs, but only four 'time slots worth' can be assigned to each shelf, that is, the first 16 BRI D-channels from any ISLU half assigned to PHs on shelf 0 require that the 17th BRI card be assigned to shelf 1.

Figure 15.2-7 PIDB Layout Example 1

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Figure 15.2-8 PIDB Layout Example 2

The key element to understand in the above DPIDB time slot analysis is that the universe of potential PH assignments, given a BRI card location, may well be limited. Depending on the DPIDB cabling and time slot fill, this limit may be to a single PH.

As can be seen, because administrators may be responsible for BRI card and PH assignments, it is essential to be aware of the cabling pattern between ISLUs and the PSU. There are three mechanisms for doing so:

(1) ***384 Specification, Table D:*** The record of data port assignments found in the engineering specifications generated by the Lucent Technologies Network Systems line engineer.

(2) ***Office Records:*** The ISLU equipage record (Office Record form 5731), (R)ISLU (remote ISLU) LGC equipage record (form 5733), and the packet switching unit PH equipage record (form 5742).

(3) ***ISA reports:*** (ISDN SM assignments) generated from DOPSMOD.

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The 384 Specification has a Table D for each SM, and there are 4 entries in the table for each DPIDB. (There are physically four cables used in the DPIDB connection, even though the discussion previously has been in terms of a single bus. One is the 'mirror' DPIDB from the other common data service group; two reflect the duplication of buses to the duplicated PSU DF. The PSU shelf is designated in the 'PORT' column of the table, that is, PSIU0 indicates PSU shelf 0. The ISLU number is designated in the 'UNIT TYPE' and 'UNIT NO.' columns, that is, UNIT = ISLU and UNIT NO. = 0 indicate ISLU number 0. The common data port number is given in the 'SRV GRP' column, with each DPIDB having a unique port number. The alphabetical designation used in the DPIDB stuffing pattern is determined as shown in Table 15.2-12 .

Table 15.2-12 Alphabetical Designation for DPIDB Stuffing Pattern

PORT	ALPHA	ISLU HALF
11	A	0
10	B	8
09	C	0
08	D	8
07	E	0
06	F	8
05	G	0
04	H	8
03	I	0
02	J	8

The Office Record form 5731 has an entry for each common data port on the ISLU. The DPIDBs are designated in the section to the far right of the form under the title 'PIDB DATA'. If a DPIDB is equipped, the value 'PSIU' appears in the 'TYPE' column. The common data port is designated in the 'NO.' column to the left of the 'TYPE' column. The SM number is in the 'SM' column, and the ISLU number appears in the 'ISLU' column. The PSU shelf is designated in the 'PSIU SHELF' column. The ISLU HALF is determined from the DPIDB alphabetic designation (derived from Table 15.2-12).

The particular ISLU to PSU cabling pattern may be optionally indicated by the telephone company traffic engineer using the 'Notes' capability of the DOPSMOD or in a separate document. It is essential for the telephone company to specify the pattern if, because of PH engineering or allocation, a nonsymmetrical pattern is required (as was the case in Figure 15.2-7). If not indicated by the telephone company, cabling assignments are performed by the Video Interactive Regional Generation of Specifications (VIRGOS) system. (VIRGOS is a Lucent Technologies program used by Lucent engineering personnel.)

While availability of time slot paths between BRI card positions and the PSU is directly dependent on the pattern and availability of time slots on the DPIDBs, the impact on the assignment process does not extend to the assignment of specific time slots. That function is performed by the switch. It is necessary, however, for the assigner to ensure that a path does, in fact, exist.

15.2.2.5 SS7 PSU in SM/SM-2000/EXM-2000

15.2.2.5.1 Feature Overview

Prior to the 5E12 software release, switching modules would communicate with the SS7 network through the CNI signaling platform. At a high level, normal operation of an SS7 interswitch call would generally proceed like this:

(1) Digit analysis in the originating switching module would determine an outgoing SS7 trunk group.

(2) A request would be sent to the Communication Module Processor (CMP) to globally hunt an outgoing trunk within the selected SS7 trunk group.

(3) The CMP would check appropriate overload controls and destination point code (DPC) routing status before hunting the trunk group. If successful, the CMP would hunt an SS7 trunk and send a message to the terminating switching module.

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(4) A terminating terminal process (TTP) would be created in the terminating SM.

(5) The TTP would assemble corresponding SS7 signaling message(s) and forward it (them) to the CNI signaling platform (through the CM and AM) for transmission to the SS7 network.

In the unlikely event that a switching module loses communication with the communication module, the isolated SM can not communicate with the CM/AM/CNI and all of its SS7 call processing will fail. From a reliability standpoint, SS7 stand-alone capability can not be supported by this architecture. The introduction of SM-based SS7 signaling allows basic SS7 subscriber features and services to communicate under normal conditions with other SS7 network elements via an SS7 packet switch unit (PSU) platform instead of through CNI. Those switching modules that have SS7 signaling links terminating are designated as Global Switching Modules (GSMs). In the unlikely event that a GSM loses communication with the AM, basic SS7 subscriber features and services will continue to function locally if the customer has provisioned the switching module for stand-alone call processing operation. The SM-based SS7 signaling platform is provided by the addition of signaling functionality on PH3s on a new or existing PSU/PSU2 on the switching module. This feature consists of the following elements:

On a PSU, it allows both the (AM-based) CNI and (SM-based) SS7 PSU signaling platforms to co-exist in the same host office. This feature allows the customer to provision up to sixteen GSMs in a *5ESS*® switch, regardless of whether CNI is equipped or not.

For those switching modules not equipped as GSMs, ISUP trunks and TCAP service applications will continue to signal through the CNI signaling platform as is done today.

On a switching module equipped as a GSM, an ISUP trunk group can be provisioned by the customer to use either CNI (if equipped) or a PSU platform for SS7 signaling message transport. This will provide a means for the service provider to transition ISUP signaling from CNI to the SS7 PSU for normal and standalone operation over time rather than being flash cut. Currently, an SS7 PSU platform will support only trunk groups terminated on the GSM. The GSM possesses a unique point code in the SS7 network.

Individual TCAP application services can be provisioned by the service provider, on a per SM basis, to use either CNI or a PSU platform for SS7 signaling. For switching modules without an SS7 PSU, CNI must be used for the TCAP message transport. For GSMs, the customer can select either CNI (default) or the GSM's SS7 PSU platform for TCAP message transport for certain service applications.

One of two SS7 PSU deployment scenarios are envisioned: (1) the SS7 PSU platform is installed as part of a new switching module and (2) the SS7 PSU platform is grown into an existing switching module of any type.

15.2.2.5.2 System Architectural Constraints and Impacts

This feature introduces an SS7 signaling platform resident on any *5ESS*® switching module (SM). A signaling link arrives as a timeslot either on a 24-channel T1 facility terminating on a DFI/DFI2 in a DLTU or on a DNU-S. A nailed-up, semi-permanent path through the TSIU connects the timeslot on the DFI/DNUS to a Signaling Terminal Protocol Handler (STPH) in the PSU. The STPH manages individual signaling links and routes SS7 signaling messages. The STPH sends an incoming application signaling message across the Packet Bus to the Packet Interface (PI/PI2) which resides in the TSIU. The PI/PI2 hands off the signaling message to call processing software in the SMP. Call processing software in the SMP sends an outgoing signaling message to the PI/PI2 which passes the message across the Packet Bus to the Message Delivery PH (MDPH). The MDPH determines the outgoing signaling link and forwards the message to the corresponding STPH terminating the selected link. The STPH routes the message to the link-level manager of an signaling link. The link-level manager sends the message across the nailed-up connection to the timeslot on the DFI. The DFI/DNU-S transmits the message in serial form on a T1 PCM bit stream. *MDPH and STPH must be PH3s*.

This feature needs the following hardware units:

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- Either (1) DFI/DFI2 in a DLTU or (2) DNU-S
- Time Slot Interchange Unit (TSIU)
- Data Fanout (DF)
- Protocol Handlers (PH) serving the STPH and MDPH roles (PH3 required)
- Packet Fanout (PF)
- Control Fanout (CF)
- Peripheral Interface (PI/PI2) in the TSIU.

15.2.2.5.3 PH Images

SS7 signaling is supported by the PH3 (TN1367) only. The SS7 signaling software is packaged in a pair of PH3S images, one for the PH3's application processor and the I/O processor.

15.2.2.5.3.1 Features Supported

The following US functionality is supported by this feature to ensure SS7 operational transparency provided by the SS7 PSU on all *5ESS*® switch CDX and VCDX switching modules:

- Integrated Services Digital Network User Part (ISUP)
- Local Area Signaling Services (LASS) features
- Number Services 800 (NS800) Application
- Inter-Switch Voice Messaging (ISVM)
- Analog Calling Name Display (CNAM) Application
- Advanced Services Platform (ASP) Release 0 and 0.1B
- Network Element Services Signaling (NESS)
- SS7 PSU MTP and SCCP Measurements
- Protocol Monitoring for SS7 (in 5E12 Software Update)

15.2.2.5.3.2 Features Not Supported

The following existing US functionality, available on the CNI platform, will NOT be supported by the SS7 PSU in the 5E12 software release:

- Leased Networks (including FTS2000)
- MTP Cluster Routing
- MTP Routing Verification Test (MRVT)
- SCCP Routing Verification Test (SRVT)
- Message trapping

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- Inter-Module Trunking (IMT)
- Software Defined Network (SDN)
- OSPS Line Information Data Base (LIDB)
- OSPS Billing Validation Application (BVA)
- OSPS *ANSI*® TCAP Type I
- OSPS Customer Account Services (CAS) SS7 Application
- OSPS LIDB Alternate Destination Application
- Inward Wide Area Telephone Service (INWATS)
- Network Access Interruption (NAI) for OSPS and *5ESS*® Toll [FDAF 98-5E-2604]
- Network Call Denial (NCD)
- Pseudo Point Code (PPC) Capability
- MTP Node Restart [FDAF 99-5E-2314]
- Signaling Link Selection (SLS) Code Expansion [FDAF 99-CP-2316]
- Improved Signaling Link Test (SLT) Procedures [FDAF 99-CP-3072]
- Network Management Support for Local Trunk Groups

This feature does not support any of the following software release 5E11 functionality:

- Multiple Point Codes (as defined in Telcordia's GR-606-CORE)
- SFG and NM for VCDX [FDAF 97-5E-2962]

15.2.2.5.4 Operations, Administration and Provisioning Requirements

15.2.2.5.4.1 Recent Change and Verify

15.2.2.5.4.1.1 Data Administration via Recent Change

The *5ESS*® switch ODA provides SS7 PSU platform office data. Examples of items for which the SS7 PSU platform requires data are signaling links, linksets, combined linksets, point codes, signaling routes, and guard timer values. The factory can build and ship SS7 PSU data in the ODD and provide corresponding Office Records. Recent Change technicians can insert, delete, and modify SS7 PSU platform data.

15.2.2.5.5 Administrative I/O Messages

MML commands allow craft personnel to determine the status of signaling links, linksets, combined linksets, and destination point codes. Link reports show detailed status including congestion, inhibited and blocked qualifications. Linkset and combined linkset reports show whether the linkset has available links for traffic and the current distribution of SLS codes over those available links. Point code reports should show whether the DPC is accessible and, if accessible, what the current route is and whether the route is congested.

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As events occur, automatic reports show the change in status for links and DPCs. MTP reports when links become available or unavailable and when DPCs become accessible or inaccessible. When a link fails, MTP reports the cause as known at the near end. MTP also reports when congestion status changes for links and DPCs.

MML commands exist to activate, deactivate, block, unblock, inhibit, and uninhibit signaling links.

MCC screens are provided to display the summary status of linksets as well as screens to provide detailed status of individual signaling links. In addition, MCC screens have menu selections that translate to the MML commands that change the state of links.

Commands to display the status of SCCP SSN access on remote DPCs exist.

15.2.2.5.6 Traffic Measurements

Measurement collection selectivity provides administration personnel with the capability to tailor which traffic measurements are collected on a per office basis. The administration personnel controls the decision as to which traffic measurements are collected in a fixed amount of AM (administrative module) buffer space. Measurements collection selectivity was introduced by the Access Interface Unit (AIU) feature and is being modified to accommodate selectivity of the new SS7 traffic reports. Traffic reports available are:

- Existing RC view 13.7 for Traffic Measurement Collection Selectivity is used to control which components have measurements collected for selected 30 minute traffic report (TRFC30) sections. because of the need to limit the number of sections being reported to the ROP, this feature provides an additional capability to specify which components will have measurements reported to the ROP.
- RC view 13.7 for Traffic Measurement Collection Selectivity is available for Review of the new TRFC30 section 230 for SIGNALING LINK (SL)
- RC view 13.7 for Traffic Measurement Collection Selectivity is available for Review of the new TRFC30 section 233 for SIGNALING CONNECTION CONTROL PART (SCCP) with the following fields:
- RC view 13.7 for Traffic Measurement Collection Selectivity is available for Review of the new TRFC30 section 234 for MTP POINT CODE (PC)
- The existing Traffic Measurement Range Selectivity RC view 13.8 is used to control which range of components is selected for measurements in each section of the 30 minute traffic report (TRFC30).
- View 13.8 for Traffic Measurement Range Selectivity is available for Review of the new TRFC30 section 230 for SIGNALING LINK (SL).
- View 13.8 for Traffic Measurement Range Selectivity is available for Review of the new TRFC30 section 233 for SIGNALING CONNECTION CONTROL PART (SCCP).
- 0RC View 13.8 for Traffic Measurement Range Selectivity is available for Review of the new TRFC30 section 234 for MTP POINT CODE (PC).
- View 13.9 for Traffic Measurement Collection Summary is available for Review of the new TRFC30 section 230 for SIGNALING LINK (SL).
- 0RC view 13.9 for Traffic Measurement Collection Summary is available for Review of the new TRFC30 section 233 for SIGNALING CONNECTION CONTRO PART (SCCP).
- RC view 13.9 for Traffic Measurement Collection Summary is available for Review of the new TRFC30 section 234 for MTP POINT CODE (PC).

15.2.2.6 SS7 PSU2 in Multiple SM-2000

15.2.2.6.1 Overview

Beginning with the 5E15 software release, new shipments of host *5ESS*® switches will utilize SS7-PSU as the SS7 signaling platform. This replaces the SS7-CNI in the *5ESS*® switch architecture, moving the SS7 signaling to an SM-2000 equipped with a packet switch unit 2 (PSU2). The SS7 signaling links will ultimately terminate on protocol handler 22s (PH22) resident on the PSU2. The new signaling platform will work with either the global messaging server (also known as the CM3) or the CM2. Additional information may be found in Switch Engineering Index (SEI 28) Signaling Gateway SS7 -PSU (Multi-SM Applications).

A conversion procedure feature to move from the SS7-CNI to the PSU based platform is introduced in software release 5E15 FR2. Refer to Section 2.3.1.14 (99-CP-4916) SS7-PSU Conversion.

15.2.2.6.2 (99-CP-4916) SS7-PSU Conversion

15.2.2.6.2.1 Feature Overview:

This feature enhances software in support of a procedure to flash cut SS7 signaling from a CNI platform to a host GSM provisioned in the office.

15.2.2.6.2.2 Software Release Availability:

This feature is available in the 5E15 FR2 software release.

15.2.2.6.2.3 Transition Management:

The feature assumes the following as part of the conversion procedure:

Prior to cutover:

(1) The required features to allow a host GSM to support all SS7 signaling needs in the office have been implemented.

(2) The host GSM is an SM-2000 equipped with a PSU2.

(3) All CCS protocol handlers (QPH, STPH) on the host GSM must be PH22s.

(4) All CNI signaling links must be in-service.

(5) All destinations (network, cluster, DPC) on the CNI platform must be accessible (primary or alternate routes).

(6) No congestion is observed on the CNI links or on routes toward remote DPCs maintained on the CNI platform.

Cutover:

- The signaling platform cutover is recommended during the lowest traffic period in the office to minimize its impact on call processing.
- A cutover device may be needed external to the *5ESS*®to swing signaling links between CNI and PSU platforms. The customer may alternately provision separate links from their STPs to each platform and designate the host GSM links as the lower priority route. In the latter case, removal of the all CNI links from service will cause the STP to alternate route over the host GSM links. Following conversion, each STP can then update its routing data to make the GSM links the primary route.
- Only in cutover mode can CNI and host GSM share the same primary originating point code (OPC)

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and alias point codes.

- Adjacent MTP restart will not be supported on the host GSM in order to reduce processing complexity during the cutover procedure. Once cutover has taken place, the customer may activate adjacent MTP restart procedures given the capability has been unsecured [SFID 177 unlocked using RC/V View 8.22 (SECURED FEATURE UPGRADE)] in the office.

- Circuit query will be inhibited during cutover mode. Following cutover, office-wide circuit query is manually requested if desired. Inbound circuit query requests shall continue to be honored during the procedure.

Recent Change:
Recent Change will be used to trigger the signaling flash cutover. Three new RC/V View 8.15 (CCS OFFICE PARAMETERS) CCS office parameters are being defined to support this procedure:

CUTOVER MODE - indicates the office is in preparation for signaling platform cutover.

HOST PLAT 1 - indicates the platform acting as the signaling interface to the SS7 network for the host office prior to actual cutover.

HOST PLAT 2 - indicates the platform acting as the signaling interface to the SS7 network for the host office once cutover has completed.

Refer to 235-118-256 *Recent Change Reference (5E15) Manual* for additional information.

Conversion Procedure:
The procedure to flash cut signaling from CNI to a host GSM is implemented in four phases:

(1) Host GSM Installation for host GSM or island GSM conversion to host.

(2) Pre-cutover mode.

(3) Cutover mode.

(4) Post-cutover mode.

Refer to 235-200-116 *Signaling Gateway Common Channel Signaling* for more information on growing a new host GSM.

15.2.2.6.2.4 Engineering Considerations:

The conversion procedure requires implementing the following features to allow a host GSM to support all SS7 signaling needs in the office:

Feature Number	Feature Name	Description
99-CP-4246	SS7 PSU Architectural Enhancements	This feature provides a CCS message transport (CMT) architecture that allows any SM in an office to send/receive CCS messages to/from a host GSM signaling platform.
97-CP-4246.G	SS7 PSU Call Processing Supporting TCAP	This feature enhances call processing software to allow TCAP applications (LASS, 800 Service, Calling Name Delivery, Inter-Switch Voice Messaging, Advanced Services Platform) on non-global SMs to send/receive TCAP messages to/from a host GSM.
97-CP-4246.A	SS7 PSU MTP Routing Enhancements	This feature enhances MTP software to support both network and cluster routing of SS7 messages. The customer is also able to assign alias point codes to a host

		GSM to allow the office to logically appear as more than one office to the network.
97-CP-4246.L	PSU-SS7 Terminal Maintenance	This feature enhances terminal maintenance software to handle ISUP trunks on non-global SMs being supported by a host GSM.
97-CP-4246.M	SS7-PSU ISUP Support	This feature enhances call processing software to allow ISUP trunks on non-global SMs being supported by a host GSM.
97-CP-4246.N	SS7 PSU Inter-Module Trunking (IMT)	This feature enhances current SS7 inter-module trunking to function in an office provisioned with a host GSM (with no CNI platform provisioned).
97-5E-7428	Decouple PSU from SMP During SM Inits	This feature enhances CCS message transport architecture between an NGSM and a host GSM to allow for a second transfer message handler (TMH) to be equipped for additional reliability. During host GSM growth, the customer has the option of provisioning one or two transfer MHs for CMT between an NGSM and a host GSM. Feature 97-5E-7428 also enhances host GSM functionality to maintain CMT path availability (where possible) to NGSMs when the host GSM encounters an SM selective initialization or CCS-preserving full initialization, thus increasing host GSM reliability. This functionality will be needed once cutover to the host GSM has taken place to effectively minimize the impact of an SM selective initialization or CCS-preserving full initialization.

The means used to switch termination of signaling links from the CNI platform to a host GSM as part of cutover procedures is dependent on service provider link hardware. Additional transmission equipment may be needed to facilitate the cutover procedure due to link termination differences between the CNI platform and the host GSM's SS7 PSU platform. To facilitate cutover where the signaling links are "moved" between platforms, a cutover device such as a digital cross connect may be used by the service provider to physically "move" the links.

15.2.2.6.2.5 Resource Impact:

The cutover procedure moves signaling link facilities between platforms in a flash cut manner. Some means to accomplish this include:

- Signaling link cutover device(s) external to the *5ESS*® switch may swing links between the CNI platform and the host GSM. A digital cross connect could perform this function.
- The service provider may provision separate links from their STPs to each platform and designate the host GSM links as a lower priority route. Removal of all CNI links from service will cause the STP to alternate route over the host GSM links. Following cutover, each STP (one at a time) can then update its routing data to make the host GSM links the primary route.

Since these methods are external to the *5ESS* ®switch and are dependent on service provider preference, no requirement is defined specific to the physical signaling link cutover. Each signaling platform cutover may need to be handled on a case-by-case basis.

15.2.2.6.2.5.1 Memory Impact:

There is no impact on the application processor (AP) by this feature. This feature will be transparent to AP needs.

15.2.2.6.2.5.2 Real Time:

SS7-PSU does not impact SMP call processing real time.

15.2.2.6.2.6 Administration Considerations:

Capacity:
For Class 5 offices the SS7-CNI is not usually a limiting item. Therefore, a "SS7-PSU" and CM3 configuration will not have a higher stated capacity than a SS7-CNI and CM2 configuration.

For Toll applications, "SS7-PSU" and CM3 configurations will have a higher stated office capacity than SS7-CNI and CM2 configurations. The SS7-PSU / CM3 busy hour call capacity is 1,000,000 calls versus the SS7-CNI/CM2 busy hour call capacity of 750,000 calls.

15.2.2.6.2.7 Measurements and Primary Service Indicators:

New Measurements:
No new measurements

Modified Measurements:
None.

Refer to 235-600-750 *Output Messages Manual* for additional measurement information.

15.2.2.6.2.8 Network Management:

For CNI-to-GSM signaling cutover, network management (NM) automatic code gap (ACG) controls currently maintained in the AM/DLN for the CNI platform will be re-learned by SS7 PSU platform following cutover. To facilitate transition from CNI, the host GSM will re-learn the NM ACG controls rather than spend real-time trying to map existing ACG controls from CNI to the host GSM. While re-learning the ACG lists will have minimal short-term impact on call processing, this is preferred over additional software complexity trying to map ACG lists maintained on the AM/DLN to the host GSM.

15.2.2.6.2.9 Engineering Tool Specifics:

15.2.2.6.2.9.1 DOPSMOD/TOPAZ:

SS7-PSU for host switch applications will be supported in Release 2 of TOPAZ (scheduled for December 2000). This feature will not be supported in DOPSMOD. The NSEP for the signaling SS7PH22. No new RTU fees are used to order the SS7-PSU platform. However, existing CCS7 software RTUs apply.

The procedure to engineer SS7 on PSU2 in the Topaz tool is as follows:

(1) Open existing office file in Topaz.

(2) Add SS7 to an existing order.

(3) Enter DNU-S trunk data for the link assignments.

(4) Order spare equipment for SS7.

(5) Generate reports.

15.2.2.6.2.9.2 Unix shell script CNIPSUDATA:

The unix script CNIPSUDATA will echo status and error messages to the craft shell and also to a log file

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(/updtmp/psudata.log) for reference after the script has executed.

Error messages is provided for the following errors and the script is stopped:

(1) No GSM is provided.

(2) The GSM is not a valid GSM.

(3) The GSM is unavailable.

(4) The CNI is not equipped.

(5) CNI data cannot be accessed.

(6) PSU data cannot be accessed.

(7) Linksets cannot be mapped from CNI to PSU.

(8) PSU has multiple linksets to the same APC.

If the script finds one of the following errors in the data already populated but can continue, the error is reported:

(1) NID XXX already populated with routes that don't match CNI.

(2) CLUSTER XXXXXX already populated with routes that don't match CNI.

(3) MEMBER XXXXXXXXX already populated with routes that don't match CNI.

(4) SCCP Network Definition already populated.

(5) NO routing data for SCCP DPC XXXXXXXXX defined.

- MTP network, cluster, member routing data that is successfully inserted on the GSM is reported.
- SCCP network definition, translation table entry and primary/backup destination data that is successfully inserted on the GSM is reported.
- A summary of the MTP routing data and/or SCCP translation data inserted is reported.

15.2.2.6.2.10 Operational Support Systems:

NOTE: This feature will NOT be tracked by Feature Activation, Counting, and Reconciliation (FACR).

Changes may be needed in the following OS interfaces:

- **Switching Control Center System (SCCS) / Total Network Management (TNM)**
  The SCCS/TNM will need to be aware of modifications and additions to input/output messages:

  (1) Introduction of the new TST:GSMNET input message to test the CCS message transport (CMT) path between non-global SM and the host GSM.

  (2) Introduction of the new UNIX tool CNI2PSUDATA to map networks/clusters/members provisioned in CNI MTP routing static data to specified GSM's MTP routing static data. This tool will also map SCCP translation type data provisioned in CNI static data to the specified GSM's SCCP static data.

- **Connect-VU**
  Connect-VU will need to be aware of modifications and additions to Recent Change views:

  (1) One new field is added to RC/V View 5.1 (TRUNK GROUP) [form RC_TKGP] to provision the CCS signaling platform used for message transport.

  (2) Three new fields are added to RC/V View 8.15 (CCS OFFICE PARAMETERS) [form RC_CPARM] to indicate whether the office is in cutover mode and also which signaling platform is actively used for CCS message transport during PRECUT/POSTCUT mode.

  (3) Cross-checks are modified for RC/V View 16.1 (GLOBAL SM) [form RC_CCGSM] to allow the GSM to be provisioned with CNI's primary and alias point codes during cutover mode.

15.2.2.7 PRI PH

The PRI is used between a *5ESS*® switch and a digital PBX or for OSPS interflow between two *5ESS*® switches. The B-channels provide circuit switch voice and circuit switch data services. The D-channel provides out-of-band signaling for the B-channels. ITU-T Recommendation Q.931 is the signaling protocol used on the D-channel. The path between the PH and the DFI is provided by the way of a nailed-up connection in the TSI. This connection involves two nailups, one from the DFI to the TSI, and the other from the TSI to the PH in the PSU.

The *5ESS*® switch supports the assignment of more than one 64 Kbps PRI D-channel per PH and up to 20 PRI D-channels can be equipped per PH. Each D-channel connection requires two nailed-up time slots; therefore, a fully equipped PRI D-channel PH requires 40 of the allowed 190 TSI nail ups.

A fully equipped PRI requires a DFI, 25 time slots, one data interface port and a dedicated PH port. The DFI requires 24 time slots for connection to the TSI, and one additional time slot for the D-channel connection between the TSI and the PSU. A PH supports up to 128 logical ports, four of which are required for the PRI D-channel. Because the B-channels do not support packet switching, no equipment is required for this capability. The loaded software configuration is required to support PRI.

An SM can have up to 20 PRIs, limited by the maximum number of DFIs per SM. Up to 19 PRIs may be assigned to a single PH2 or PH3. The DOPS assigns a maximum of 19 PRIs to a DLTU equipped ISDN SM, provided that there are 19 or 20 DFI circuits in the ISDN SM. If 20 PRIs are desired, the 20th must be edited with a second PSU shelf and another PH. The PRI D-channels may be mixed on the same PH with BRI, permanent packet B-channel (PPB), and BRI D-channel assignments. Mixing PRI channels with BRI channels on the same PH creates more difficult PSU arrangements and may impact time slot use in the ISLU, resulting in fewer BRIs per SM. It is for these reasons that mixing is not recommended and no engineering is provided for mixing.

The PRI D-channel traffic is limited to Q.931 call processing packets, which can include up to 512 bytes of ISDN user part (ISUP) information. One possible model for this traffic assumes an average of seven Q.931 packets and four data packets per call. Because the D-channel carries signals for 479 (with a theoretical maximum of 36 CCS) a D-channel should handle a maximum of about 20 calls per hour (assuming a 180-second holding time per call). This translates to a rate of 0.04 dpps.

A PH supports up to thirty-two 64 Kbps channels, equipped on every fourth port beginning with port 0. Because a maximum of 20 PRIs may be equipped per ISDN/SM, a maximum of twenty 64 Kbps PRI D-channels can be equipped per PH. This is increased to 31 on the SM-2000. The DFI and the PH must be equipped on the same SM.

The XAT feature allows individual digital signal level (DS0) channels on a T1 facility to be configured on a subscription basis for X.25 packet-switched data access. Up to 24 channels of a T1 facility can be

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configured for packet-switching. Any remaining channels on the T1 facility can be used for other digital services available on the switch; for example, PRI or circuit-switched connections to a digital PBX. The number of channels chosen to carry the X.25 traffic can also be changed by subscription. The packet-switched DS0 channels on the T1 facility are not aggregated but remain channelized. For Engineering and Administration information see the ISDN SOFTWARE UPDATES section.

15.2.2.8 X.75´-Phase 1 Gateway to Public Packet-Switched Network

The X.75´-Phase 1 Gateway to a public packet switched network (PPSN) feature specifies the protocol used and the capabilities provided to allow a *5ESS*® switch (ISDN) owned by a telephone company to connect with a PPSN owned by the same telephone company. Both switches must reside in the same local access and transport area (LATA). With this feature, end-users of X.25 packet switching on the *5ESS*® switch are allowed to reach any end point accessible from the PPSN. Each *5ESS*® switch can access the PPSN either by directly supporting an X.75´ interface to it or via a Lucent Technologies internal protocol trunk group to another *5ESS*® switch that has an X.75´ interface. Time slots from the TSIU to the PSU are allocated via recent change view 22.2.

15.2.2.9 Multiple Internal Protocol Trunk Groups

This feature supports multiple packet switching trunk groups on a *5ESS*® switch using the Lucent proprietary IP. Each trunk group connects two *5ESS*® switches in an IP subnetwork in a LATA. This development will make it possible to have an exclusive network of *5ESS*® switches in a LATA.

This feature allows availability of a maximum of 16 trunk groups, one destination per trunk group, and 32 trunks per group on a single *5ESS*® switch. In addition to providing the capability to tandem IP packets, this feature also allows alternate routing and reconnect recovery procedures.

15.2.2.10 On-Demand B-Channel Packet Switching

On-demand B-channel packet switching allows the B-channels on a BRI to be used to support voice, circuit switching, or packet switching on a dynamic basis. One possible application of this feature is for users that occasionally require higher performance X.25 packet switching service (that is, lower transmission delays, or higher throughput) than achievable on a D-channel. Another possible application of this feature is an office where each BRI is likely to have both voice and data (X.25 packet switching terminal) station sets. The requirements of each X.25 packet terminal will be such that D-channel packet switching will not be adequate to serve the needs of some of the users. For ease of administration, the service provider may elect to provision all BRIs with on-demand X.25 packet switching service on the same PH.

15.2.2.11 ODB Assignment Guidelines

On-demand B-channel lines can be assigned anywhere within the ISDN line peripheral, except the EAIU. They are not restricted to the same assignment rules as the PPB or D-Packet BRI/DSLs. ODB channels have full connectivity from the line peripheral to the PSU shelf. Prior to assigning ODB lines, translations have to be completed in the switch (Recent Change View 23.13 ODB TS Allocation and View 23.14 ODB ISCN Reservation) specifying the ISCNs and the number of time slots to allocate for ODB. The ODB BRI/DSLs automatically path hunt for an available DPIDB time slot within the switch. ODB lines use available time slots on any DPIDB to reach the appropriate PSU shelf and ODB PH. Based on the number of time slots allocated and the number of BRI/DSLs assigned, the user may encounter blockage. The switch administrator must be careful not to assign more ODB lines than traffic engineered.

15.2.3 ASSIGNMENT METHODOLOGY

15.2.3.1 Objectives

At this point, the reader should have a firm understanding of the task faced by the ISDN BRI/DSL line

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assigner and the constraints placed on that task. The parameters of this process are summarized in Table 15.2-13 .

Table 15.2-13 BRI/DSL Assignment Considerations

PARAMETER	RESOURCE
Termination & Type	ISLU, Cards
Circuit Usage (CCS)	ISLU
Active B-Channels	LIDB, DPIDB
Packet Channels	PH
Packet Usage (PPS)	PH
Virtual Circuit	PH
DPIDB Time Slots	ISLU, LGC, PH

The description has highlighted four main points:

- The assigner ***must*** direct assignments in a way envisioned by the traffic engineer in terms of equipment quantities provided and assumptions made regarding the characteristics of the user demand offered to the switch. This is to fully utilize the limited resources engineered. Assignment directions are stated in terms of the parameters of resource use (cards, CCS, dpps, etc.).
- In the ISLU, assignments are directed by the equal distribution of line card quantities and card configurations assigned to each ISLU and, within ISLUs, each line group. After cutover, usage statistics replace card quantities in terms of ISLU assignments, but configuration distribution must be maintained over LGCs.
- In the PSU, specific packet switching applications are needed to estimate resource demand with assignment direction being determined by a numerical distribution in a precutover environment, or traffic data after cutover.
- Optimal line card and PH assignments address different architectural constraints and are driven by (quite probably) independent parameters of demand. The assignments thus directed are not independent, however, since the architecture restricts the association of PHs and line card positions.

A figurative description of the BRI/DSL assignment dilemma is the requirement to choose two 'ends' and make sure that they meet in the 'middle.'

15.2.3.2 Methodology Overview

An ISDN assignment methodology must allow the BRI/DSL line assigner to track the use of resources in a proper manner (as designed by the traffic engineer) considering the constraints placed on that use. In perhaps simplistic terms, the assigner must be able to see where space exists.

15.2.3.3 Equipment Configuration

The next step for the administrator is to know the configuration of the equipment that was engineered. This section identifies the information required to understand how the office is configured for ISDN. The office configuration may be obtained from the ISA report, ODA forms, Office Records, or Recent Change/Verify Views.

15.2.3.3.1 ISA Report

The ISA report is created in DOPS when ISDN is engineered in the *5ESS*® switch. The ISA report shows the equipment configuration of the ISDN hardware in the SM. In DOPS, the ISA report can be assessed from four levels; ISDN, ISLU, IDCU, or PSU.

NOTE: In Software releases where both DOPS and DOPSMOD are the engineering tools, you will need to be sure to check the ISA reports from both tools for complete information.

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The traffic engineer can access two versions of the ISA report in DOPS: SUMMARY and EXTRACT. The SUMMARY version provides the entire layout of ISDN SMs via the ALL option, including the number and type of BRI/DSL cards, ISLU and PSU layout (including Line Group Controllers, DPIDBs, PIDBs, PSU Shelves, and Protocol Handlers), MAN, HLSC, and RG circuit packs, and type of wiring (2 or 4) for each ISLU.

The EXTRACT version of the ISA report enables the DOPS user to determine if the ISDN configuration generated in DOPS is consistent with the traffic engineers' assumptions. The EXTRACT Version contains the ISDN community parameters common to the ISDN SM, the SM PIDB, LG breakdown, and resources (time slot demands). The ISLU layout and the PSU layout are not included in this version.

The ISA report is part of the Traffic Engineering Order (TEO). The traffic engineer has the responsibility to maintain the DOPS data base for each *5ESS*® office, including ISDN. It is imperative that DOPS be updated to reflect any additions or changes of the engineered equipment; whether the change is the number of BRI/DSL cards or an additional ISDN SM. Changes can be made to the original order of the ISDN equipment layout if the traffic engineer has not specified a proposed equipment layout or if the Lucent Technologies Regional Engineer identifies potential equipment savings or problems. When there is a need for Lucent Technologies to modify the original request for equipment on the TEO, the service provider equipment engineer must be notified and must give Lucent Technologies permission to change the order.

NOTE: In the current DOPS, users may assign any number they wish to an ISDN SM, PSU, or ISLU by using the external number command. The *DOPS User's Guide* 235-060-100 has detailed information for editing the ISDN SM number using the **extnbr** command.

15.2.3.3.1.1 Using the ISA Report

The ISA report is used by traffic engineers and switch administrators to determine capacity and future growth of ISDN equipment. The switch administrator also uses the ISA report to determine the equipment layout of the ISDN equipment; including the ISDN peripherals, BRI/DSL cards, PIDBs, DPIDBs, PSU shelfs, and PHs (PPB, ODB, D, ISM, etc).

NOTE: The ISA report changes with each growth order to the office. It is important that the ISA report used is the most current version available for a specific project. The DOPSMOD data base is updated by the traffic engineer to reflect any office changes. Administrators should contact their respective traffic engineer to verify the ISA report is the most current issue.

Since office updates change the original ISA report, once new ISDN equipment is in the *5ESS*® switch, the switch administrator or the traffic engineer should verify the equipment layout on the ISA report with the actual switch configuration. Request the appropriate Switching Control Center (SCC) or technicians to obtain the Office Records or recent change views (RC/V) used to verify the ISDN equipment layout. Detailed information for the Recent Change/Verify Views, Office Data Assembler (ODA) Forms, and Office Records can be found in Sections 14.2.3.3.2 , 14.2.3.3.3 , and 14.2.3.3.4 .

15.2.3.3.1.2 DOPSMOD User Inputs and Sample TEO Version of ISA Report

This section illustrates engineering a sample ISDN office. The first step is to determine the number of BRI/DSLs and the type of service they will provide. In our sample office we have assumed demand for service as listed in the following paragraphs. This section includes the DOPSMOD ISDN inputs and the TEO version of the ISA report.

The traffic engineer determines the number of BRI/DSLs required for the office by using marketing forecasts or customer requests for service. In addition to the number of lines, the traffic engineer accumulates additional data to input into DOPSMOD, such as the type of service(s) per BRI/DSL, anticipated CCS and dpps, ISM Link requirements, and trunking needs (X.75, X.75´ and IP).

The ISDN inputs for the example are listed in Table 15.2-14 . The values indicated are per ISLU2. A total of 960 ISDN lines are required, therefore, two ISLU2s will be engineered.

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Table 15.2-14 Complete ISDN ISLU2 Inputs

Circuit Switched Requirements			Packet Switched Requirements		
Equipment		CCS/line	Equipment		PPS
1 B lines	200	8.47	PPD	- - -	1.6
2 B lines	280	8.47	PPB Users	10	32
ODB lines	15	5	ODB	- - -	1
T - BRIs	128		Users per line	1	- - -

ISDN trunks are also required for this office. The trunk requirements are shown in Table 15.2-15 below.

Table 15.2-15 ISDN Trunk Requirements

Trunk Requirements	Quantity
Custom PRI	1
XAT	6 @ 16 PPS each
IP	2
X75P	2

Three inputs are input by the STARTUP mode in DOPSMOD, they are as follows:

xph3ppd = yes

xph3odb = yes

xph3ppb = yes

Refer to the *DOPS Engineering Procedures* 235-060-110 for a complete list of all DOPS Symbols used to engineer the *5ESS*® switch.

The TEO version of the ISA report is shown in Table 15.2-16 .

Table 15.2-16 Office Totals

		ISLU	IDCU
CCSPTSM	HD WEIGHTED AVG CCS/BRI/DSL CARD	10.20	
BRITCRD	BRI T LINE CARDS	165	
U2B1QCD	BRI 2B1Q U LINE CARDS	768	
UAMICD	BRI AMI U LINE CARDS	0	
ZCRD	Z LINE CARDS	27	
TUZCRD	TOTAL LINE CARDS	960	0
TR303	NO. OF TR303 RTS IN IDCUs		0
TR008	NO. OF TR008 RTS IN IDCUs		0
NRT	NO. OF PUB43801 DS1s IN IDCUs		0
DPPS	WEIGHTED AVG PPS / D-CHANNEL	1.60	
PPB	NO. OF PERM. PKT B-CHANNELS	20	0
PPBPPS	PERM. PKT B PEAK PPS PER PPB	32.00	0.00
ODB	NO. OF ON-DEMAND B USERS	30	0
ODBCCS	DPIDB OCCUPANCY CCS PER ODB	5.00	0.00
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	1.00	0.00
PH2SPR	NO. SPARE PH2 / PSU SHELF	1	
PH3SPR	NO. SPARE PH3 / PSU SHELF	1	
XISTF	ISTF OPTION (YES / NO)	Y	
IDCU	NO. OF IDCU UNITS		0
XSPLFCT	UNIFORM INTER-SM CONN. FACTOR	1.20	
BRIPLGC	BRI CARDS / LINE GRP CNTRLR	32	
MAXPIDB	MAXIMUM PIDBS AT THIS CCS-ISLU	12	
BRILGC	NO. LGC REQD FOR BRI/DSL - ISLU	30	
ISDNSM	NUMBER OF ISDN SMs REQUIRED	1	
DLTUSM	NUMBER OF ISDN SMs WITH DLTU	1	
PRI	NO. OF PRI D CHANNELS	1	
XAT	NO. OF XAT CHANNELS	6	
XATPPS	WEIGHTED AVG PPS/XAT-CHAN	16.00	
IP	NO. OF IP TRUNKS	2	
X75	NO. OF X.75 TRUNKS	0	
X75P	NO. OF X.75´ TRUNKS	2	

Table 15.2-17 shows the ISDN SM No. 1 version.

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Table 15.2-17 ISDN SM No. 1

		ISLU		IDCU	
SUMMARY		**QTY**	**PH**	**QTY**	**PH**
CCSPTSM	HD WEIGHTED AVG CCS/BRI/DSL CARD	10.20			
BRITCRD	BRI T LINE CARDS	165			
U2B1QCD	BRI/DSL 2B1Q U LINE CARDS	768			
UAMICD	BRI/DSL AMI U LINE CARDS	0			
ZCRD	Z LINE CARDS	27			
TUZCRD	TOTAL LINE CARDS	960	PH3	0	
TR303	NO. OF TR303 RTs IN IDCUs			0	
TR008	NO. OF TR008 RTs IN IDCUs			0	
NRT	NO. OF PUB43801 DS1s IN IDCUs			0	
PPB	NO. OF PERM. PKT B-CHANNELS	20	PH3	0	
PPBPPS	PERM. PKT B PEAK PPS PER PPB	32.00			
DPPS	WEIGHTED AVG PPS/D-CHANNEL	1.60			
ODB	NO. OF ON-DEMAND B USERS	30	PH3	0	
ODBCCS	DPIDB OCCUPANCY CCS PER ODB	5.00			
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	1.00			
X2DTU1H	NO. DFI CIRCUITS	4			
PRI	NO. OF PRI D CHANNELS	1	PH3		
XAT	NO. OF XAT CHANNELS	6	PH3		
XATPPS	WEIGHTED AVG PPS/XAT-CHAN	16.00			
IP	NO. OF IP TRUNKS	2	PH3		
X75P	NO. OF X.75´ TRUNKS	2	PH3		
PH2RAT	PH2 PER DPIDB (1/4 ISLU BASIS)	4.58			
PH3RAT	PH3 PER DPIDB (1/4 ISLU BASIS)	1.34			
ISMPH	AVG INTER-SM PROTOCOL HANDLERS	**a**	PH3	**b**	
PSUSHVS	NO. PSU SHELVES IN THE ISDN SM	2			
DSU2IF	QTY OF ISTF PACKS ON DSU-2	1			
IDCU	NO. OF IDCU UNITS			0	
RPATS	RESERVED RPA/RPM T.S. PER SHF	0			
INSMPPS	EST. PPS FOR INTER-SM PKT TPT	0			

Notes:

a. 0 Estimated

b. 0 Assigned

SM PIDB and LG breakdown	PIDBs	LGs
ISLU# 1	10	15
ISLU# 2	10	15
SUM PIDBs	20	
SUM LGs		30

Figures 15.2-9 and 15.2-10 list the ISLU1 and ISLU2 protocol handler assignments.

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Figure 15.2-9 ISLU 1 Protocol Handler Assignments

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Figure 15.2-10 ISLU#2 Protocol Handler Assignments

Figure 15.2-11 shows the PSU1 and trunk/channel protocol handler assignments.

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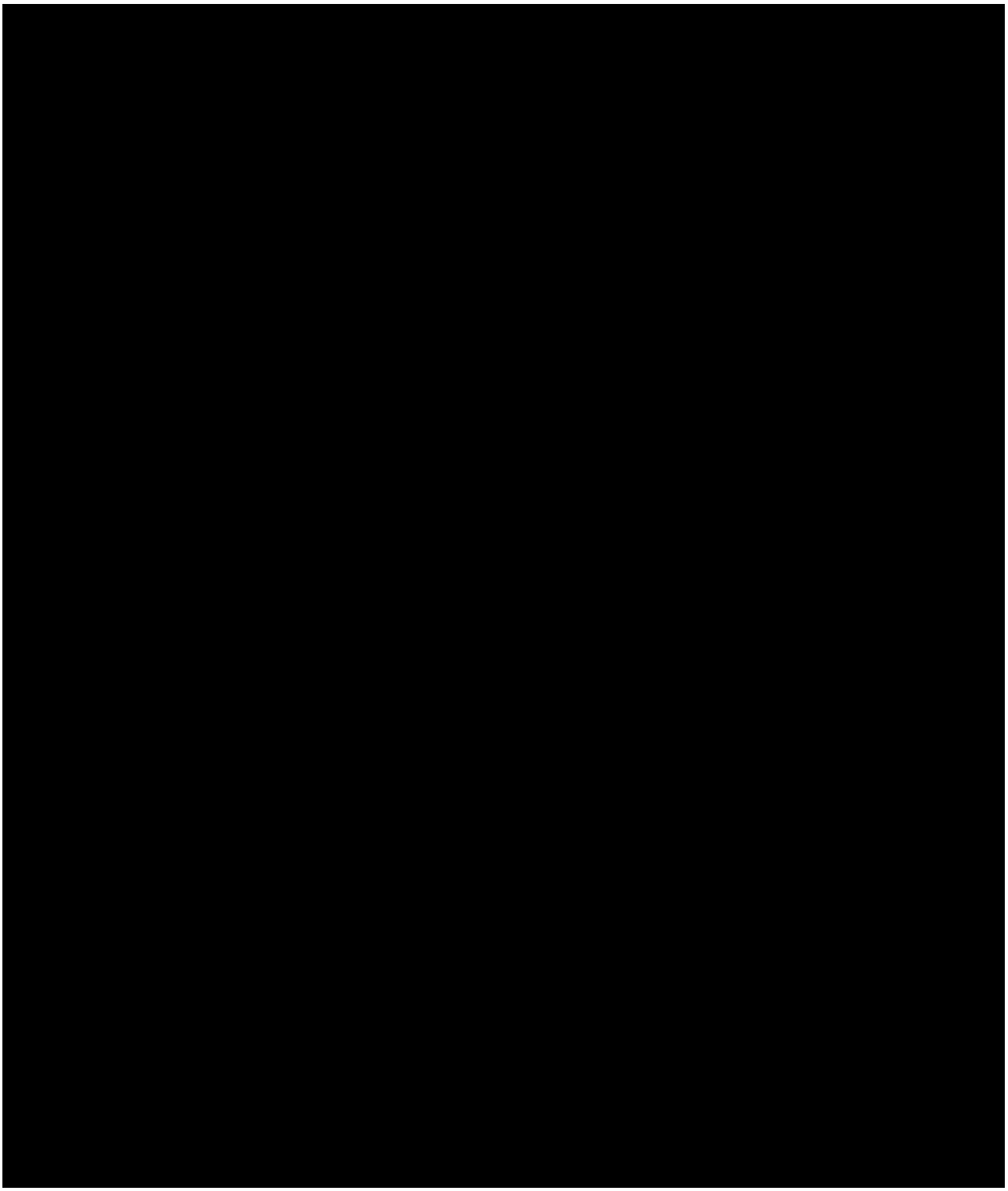

Figure 15.2-11 PSU1 and Trunk/Channel Protocol Handler Assignments

15.2.3.3.2 Office Records

A set of forms are available in the Office Data Administration (ODA) system containing Office Records that are similar to and sometimes the same as *5ESS*® Switch Office Records. Both ODA and *5ESS*® Switch Office Records are tabular listings of the actual inventories and assignments of the data base and serve as a means for administering the *5ESS*® switch office. Copies or variations of the Office Record forms may be used as work sheets to aid administrative and maintenance personnel in translation inputting and data

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entry into the ODA process. Please note that although many similarities exist between *5ESS*® Switch Office Records and ODA forms, the two are not the same and should never be interchanged. The ODA forms are used in preparing a *5ESS*® switch for startup while *5ESS*® switch Office Records are used only in an already working *5ESS*® switch. Where the records inventory the same data and serve the same purpose, the ODA form and *5ESS*® switch Office Record should have the same number.

Office records are available on-line at any time on the *5ESS*® switch. Office records are based upon the recent change and verify views of the *5ESS*® switch and are applicable no matter what operational support system is attached to the switch. Office records can be accessed, changed, or input with standard I/O messages on a message-type terminal. These systems include menu mode and text interface recent change as well as Remote Memory Administration System (RMAS) or the master control center (MCC) in the command (CMD) mode.

The RC/V facility is a user interface provided by the *5ESS*® switch that allows users to modify or verify the contents of the ODD data base on the *5ESS*® switch.

Refer to 235-080-100 *5ESS*® *Translation Guide (TG-5)* and 235-118-XXX *Recent Change Manuals* for a current listing of Office Records, ODA Forms, and Recent Change Views.

15.2.3.3.3 Integrated Service Line Unit (ISLU)

This section identifies the questions that the administrator should ask to determine the ISLU configuration and the answers to those questions. The sample ISA report (Figure 15.2-12) illustrates, with "keyed" values (**Item A**, **Item B**, etc), the location on the ISA report where the questions are answered.

(1) How many ISDN SMs (Switching Modules) are equipped?

The number of ISDN SMs required are engineered via the DOPS system based on the number of BRI/DSLs and/or analog lines and their associated usage. The Office Totals page of the ISA Report identifies the number of ISDN SMs provided in your office. The symbol to look for is as follows: ISDNSM NUMBER OF ISDN SMs REQUIRED **Item A**

(2) What SMs are equipped with ISDN?

Once the number of ISDN SMs have been identified, the next step is to determine the actual SM(s) number where the ISDN hardware will be located. The ISDN SM NO. 1 (our example shows number 1) page should indicate the correct SM number. Remember, the traffic engineer should edit the original report with the **entnbr** command in DOPSMOD so that the correct SM number appears on the ISA report (**Item B**).

(3) How many ISLUs are equipped in the ISDN SM?

The number of ISLUs equipped within the SM can be found on the ISLU Protocol Handler Assignment and the ISDN SM No.1 page of the ISA report (**Item C**).

(4) How are the ISLU drawers wired? Are they 2- or 4-wire?

This information is obtained from the 5EMELD report provided to the service provider equipment engineer. Remember, you need to know how the drawers are wired because it makes a difference for the type of cards that can be assigned in them.

(5) How many Line Group Controllers (LGCs) are equipped within each ISLU?

The LGCs are traffic engineered and the ISLU can be equipped with a maximum of 16. The LGCs are numbered 0-15.LGCs 0-7 are resident in ISLU Half 0 and LGCs 8-15 are resident in ISLU Half 1. When your office is engineered, you cannot assume that all LGCs are equipped in the ISLU, or ISLU Half. For example, LGCs 0-5 may be equipped in ISLU Half 0 and LGCs 8-10 may be equipped in

ISLU Half 1.

The number of LGCs engineered for your office can be found on the office totals page of the ISA report (**Item E**). The number of LGCs equipped per ISLU can be found on the ISLU Protocol Handler Assignments page of the ISA report (**Item C**).

Other forms that can assist in obtaining or comparing the information noted on the ISA report are listed below:

ODA	Form eqlgc	Provides information on equipped and operational LGCs.
RC/V	22.6	Same as above
Office Record	Form 5733	Same as above

An entry of "O", for OPERATIONAL, in the "EQST" column indicates that the LGC is equipped.

Each equipped LGC must be defined in the Operational Support System used to assign the ISDN lines.

NOTE: The ISA report refers to ISLU Half as half 1 and half 2. All other documentation refer to ISLU Half as 0 and 1. 0 and 1 is the correct reference for ISLU Half.

(6) What type of cards are being provided?

You can be provided with:

- T-Cards (4-wire card) must be assigned in a 4-wire drawer.
- U-Cards (2-wire card) can be assigned in either a 2- or 4-wire drawer.
  - 2B1Q U-Cards-National ISDN U-Cards
  - AMI U-Cards-Nonstandard U-Cards cannot be used for National ISDN BRI/DSLs
  - Pseudo U (allocation only, requires no new hardware)
  - Pseudo T (allocation only, requires no new hardware)
- Z-Cards (analog card) can be assigned in either a 2- or 4-wire drawer.

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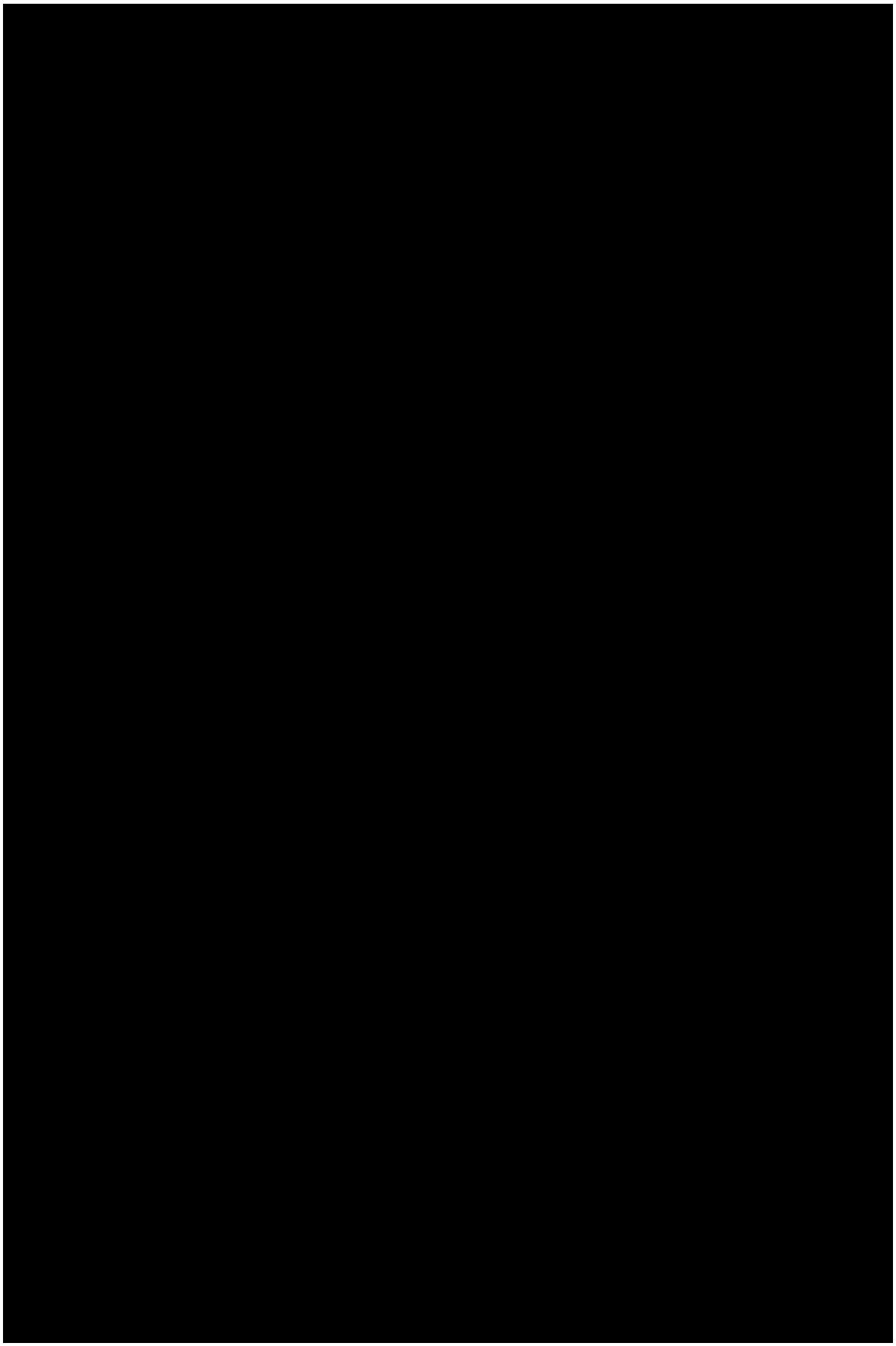

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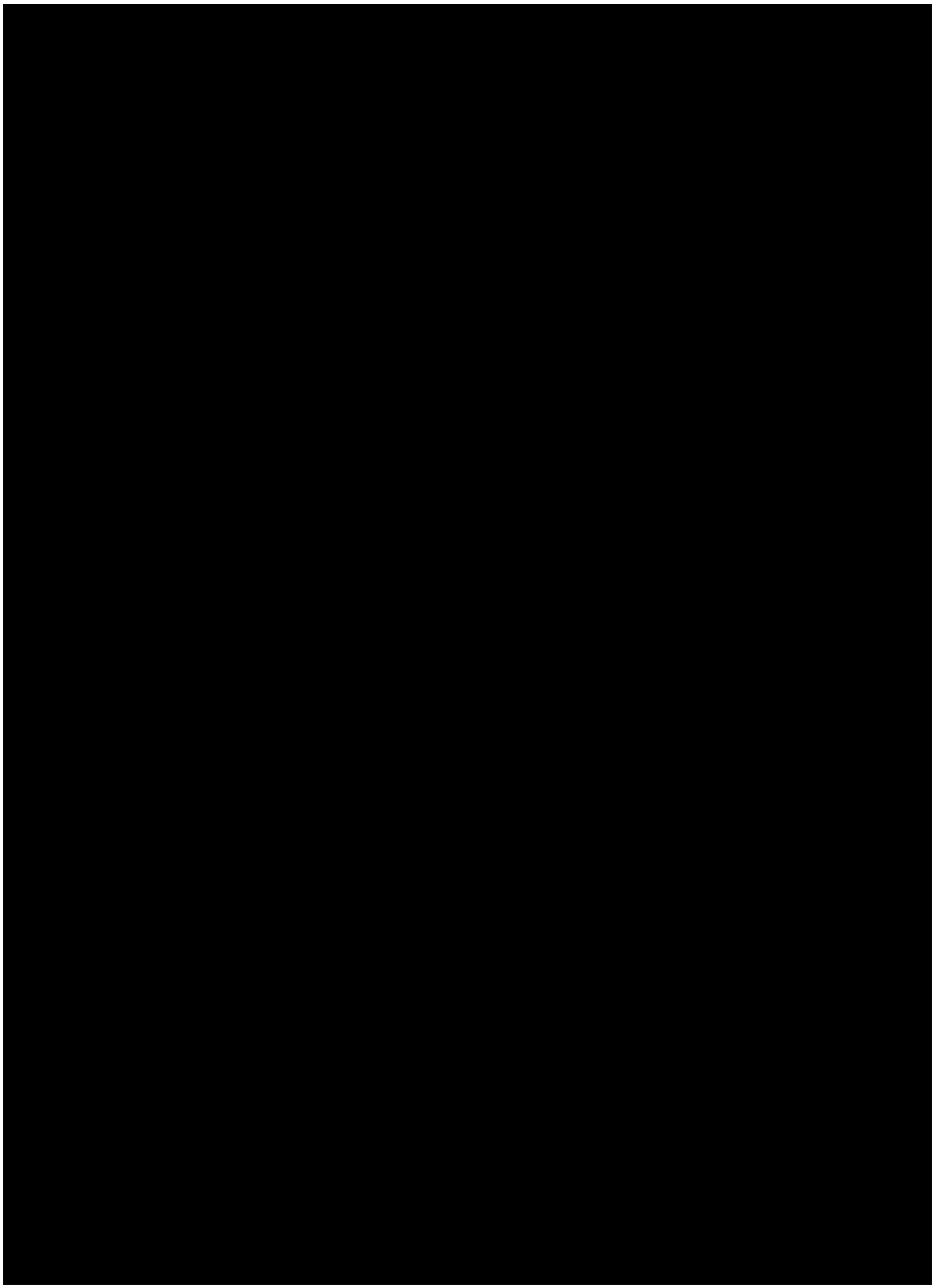

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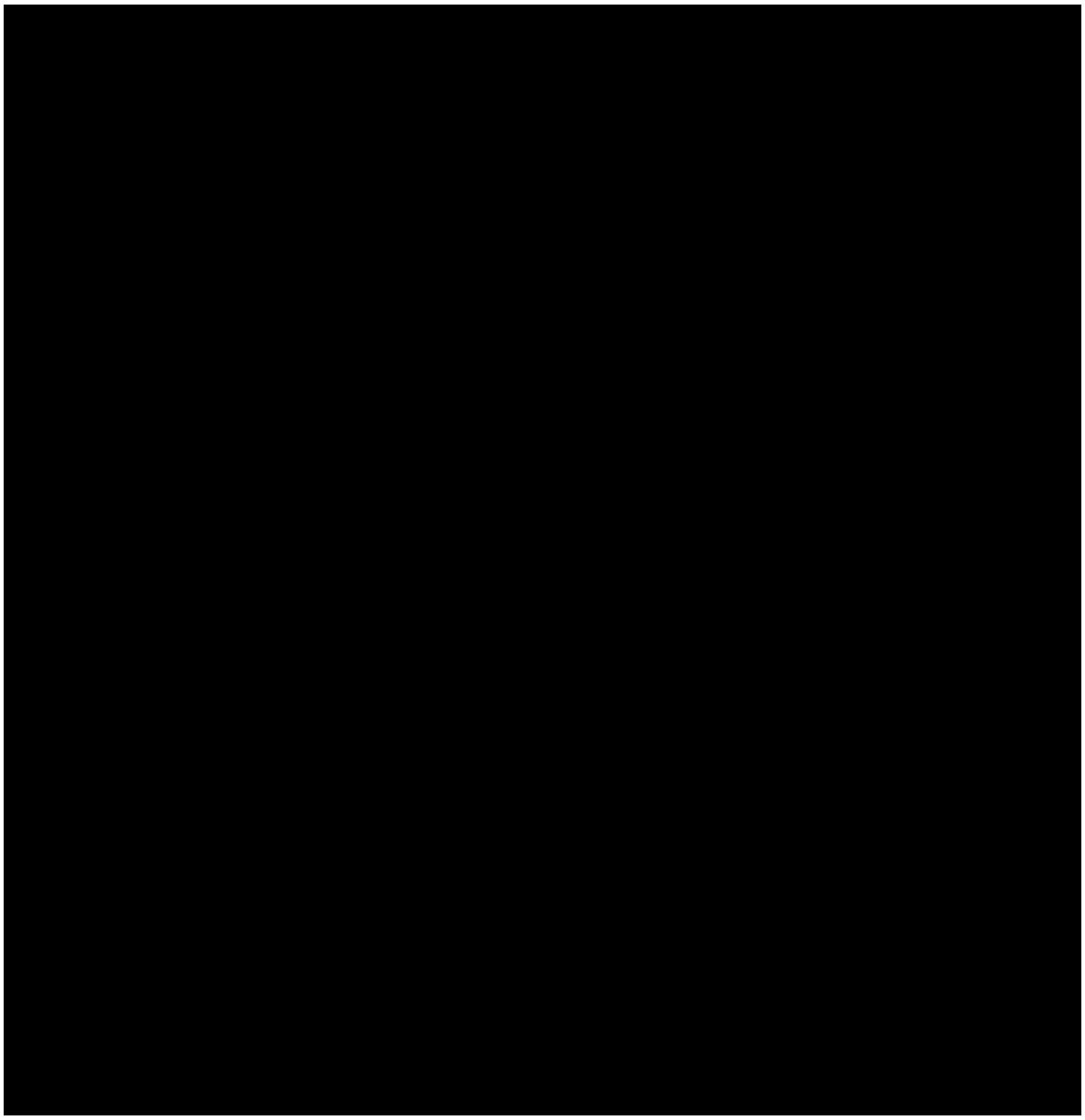

Figure 15.2-12 Sample ISA Report

There are two types of U-cards; AMI and 2B1Q. Each U-card type requires an NT1 device on the customer premises. The NT1s are not interchangeable between AMI and 2B1Q U-cards so it is important to assign the correct type of card. Service orders must specify the proper card to be assigned.

When ISDN offices are equipped with both versions of U-cards (for example, AMI and 2B1Q), the operational support system utilized to perform assignment of the Line Card Equipment Numbers (LCENs), must be able to specify each equipment type as needed for assignment.

NOTE: Drawers equipped with U- and Z-cards require the ISLU to be equipped with HLSCs.

The number of cards engineered for your office can be found in the Office Totals, and ISDN SM No 1 pages of the ISA report. The symbols to look for are as follows:

BRITCRD	BRI T LINE CARDS	
U2B1QCD	BRI/DSL 2B1Q U LINE CARDS	
UAMICD	BRI/DSL AMI U LINE CARDS	**Item G**-Office Totals
ZCRD	Z LINE CARDS	**Item I**-ISDN SM #1

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TUZCRD	TOTAL LINE CARDS

(7) How many cards are equipped per LGC?

The LGC is a subunit of the ISLU, which can be equipped with up to 32 line cards. It is possible for an LGC to have a mixture of T, AMI U, 2B1Q U, and Z cards. An LGC can be wired for either 2-wire or 4-wire ISDN interfaces (note that analog lines are 2-wire interfaces). All types of cards may be equipped in the 4-wire LGCs, but only U- and Z-cards can be equipped in 2-wire LGCs. The Operational Support System used to assign U- and Z-cards should assign LCENS to 4-wire LGCs only if the 2-wire LGCs have been totally assigned.

Normally, offices are engineered with 32 cards per LGC, but the engineer has several options for customizing the configuration. For example, if high-usage channels are engineered on the same PIDBs with other D-channels, and all the LGCs are equipped in the ISLU, the maximum number of cards that can be equipped per LGC depends on the number of high-usage channels engineered per LGC. High-usage channels are D-channels engineered at greater than eight dpps, and all B-channels. The traffic engineer can tell you how many high-usage channels are engineered per ISLU. Which LGCs in the ISLU these are assigned to is an assignment option (usually, high-usage channels should be spread evenly across the LGCs in an ISLU). The maximum number of cards is limited as shown in Table 15.2-18 .

Table 15.2-18 LGC Card Requirements

NUMBER OF HIGH USAGE B	**MAXIMUM NUMBER OF CARDS**
0	32
1	28
2	24
3	20
4	16
NUMBER OF HIGH USAGE D	MAXIMUM NUMBER OF CARDS
0	32
1	29
2	26
3	23
4	20

In some instances, an ISLU may be engineered at traffic limits and may have less than 32 cards per LGC, even though there are no high-usage channels engineered. In these cases, the traffic engineer can tell from the DOPSMOD run the appropriate value for maximum cards.

The total number of BRI/DSL cards to be equipped per LGC can be found on the Office Totals page of the ISA report. The symbol is as follows:

BRIPLGC BRI/DSL CARDS / LINE GRP CONTRLR **Item H**

The number of cards engineered for the ISDN SM can be found on the ISDN SM No.1 (Remember, the traffic engineer should update this form to indicate the actual SM number (**Item B**) page of the ISA report. The symbols to look for are as follows:

BRITCRD	BRI T LINE CARDS	
U2BB1QCD	BRI/DSL 2B1Q U LINE CARDS	
UAMICD	BRI/DSL AMI U LINE CARDS	**Item I**
ZCRD	Z LINE CARDS	

The number of cards engineered for the ISLU can be found on the ISLU PROTOCOL HANDLER ASSIGNMENTS page of the ISA report. The symbols to look for are as follows:

BRITCRD	BRI T LINE CARDS	
U2B1QCD	BRI/DSL 2B1Q U LINE CARDS	Item J
UAMICD	BRI/DSL AMI U LINE CARDS	
ZCRD	Z LINE CARDS	

Other methods to obtain card type and position within the ISLU-LGC are as follows:

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ODA	islulc	Provides information on card type, status - equipped, operational, unequipped, or spare
RC/V	22.7	Same as ODA islulc
Office Records	Form 5942	Same as ODA islulc

(8) Are software-controlled spare cards to be used within the ISLU/LGC?

The service provider may choose to designate up to two line cards (position 15 and 31) in each line group as software controlled spares (U-cards only). The decision to spare line cards is a service provider option and should be determined by local practices. It is recommended that the traffic engineer verify whether the software controlled cards are to be allocated. Refer to the TG-5, Division 5, Section 5c for instructions on spare card assignment requirements. Spare cards are specified on the same ODA, RC/V, or Office Records as the line cards in question 7.

(9) How many PIDBs are equipped to provide your circuit switched data and voice traffic?

The ISLU may be equipped with 2 to 16 PIDBs. PIDBs always come in pairs (2, 4, 6, etc). The number of PIDBs equipped on each ISLU in your office depends on the traffic load specified during the engineering process. The number of PIDBs equipped determines the CCS capacity of the ISLU.

The ISLU Protocol Handler Assignments page of the ISA report provides the number of PIDBs engineered per ISLU. Look for the following label:

PIDB **Item K**

10

This is determined by the value of CCSPTSM "HD Weighted AVG CCS/BRI/DSL".

Other methods to obtain amount of equipped PIDBs per ISLU Half are as follows:

ODA	eqislu	Used to define ISLU configuration of PIDBs and DPIDBs.
RC/V	22.5	Same as ODA eqislu
Office Records	Form 5731	Same as ODA eqislu

To determine the number of PIDBs equipped on each ISLU- count the number of entries in the PIDB data section of the form that have a type = "SHRD." (Be careful to count the entries for each ISLU since all ISLUs in the office appear in the table and all the ISLUs may not have the same number of PIDBs). Since the table represents a simplex (one side only) view, multiply the number for each ISLU by two.

(10) How many DPIDBs are equipped to provide your packet-switched data traffic?

The ISLU may be equipped with up to 10 DPIDB pairs. The number of DPIDBs equipped on each ISLU in your office depends on the traffic load specified during the engineering.

The ISLU Protocol Handler Assignments page of the ISA report provides the number of DPIDBs by describing the DPIDB path engineered between the ISLU Half and the PSU Shelf (the path to provide access to the PH) **Item\OL**. The report also provides the DPIDB name (A, C, E, etc.) and number (11, 9, 7, etc.). This information is used to allocate the available time slots for assignment as discussed later in the section (**Item M**).

Other methods to obtain amount of equipped DPIDBs per ISLU Half are as follows:

ODA	eqislu	Used to define ISLU configuration of PIDBs and DPIDBs.
RC/V	22.5	Same as ODA eqislu
Office Records	Form 5731	Same as ODA eqislu

The ODA Form "eqislu" and Office Records Form 5731 include DPIDB assignment information for each ISLU. (Refer to Translation Guide TG-5 for an example of Form 5731 and details concerning

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its completion.)

The software in the *5ESS*® switch allocates odd-numbered (11, 09, 07...) DPIDBs to LGCs 0 through 7 (ISLU half:0), and allocates the even numbered (10, 8, 6...) DPIDBs to LGCs 8 through 15 (ISLU half:1) (**Item M**). In effect, the switch allocates the DPIDB time slots to an ISLU HALF. The Assignment System needs the DPIDB configuration to track the number of time slots still available for assignment. Each time slot is determined and assigned via recent change in the switch.

To determine the number of DPIDBs equipped in each ISLU HALF connected to each of the five PSU shelves, refer to Office Records or ODA Form/Screen 5731. For "ISLU half:0," count the number of odd-numbered entries with type="PSU" for each shelf and enter that data in the appropriate field on the ISLU configuration screen. Be careful to count the entries for each ISLU since all ISLUs in the office appear in the table and the ISLUs may not have the same number of DPIDBs for each "ISLU half:0".

To determine the number of DPIDBs in "ISLU Half:1" refer to ODA Form/Screen 5731, and count the number of even-numbered entries with type="PSU" for each shelf.

(11) Is the main frame a *COSMIC*® module frame? Do you have concerns about the short jumper concept?

It is important to find out if your office has a *COSMIC*® module frame using a short jumper concept in assigning the office equipment to the cable and pair. With this type of application on the frame, the cable and pair determines the assignment of LCENs and may have an affect on the capacity of LCEN or the administrator may have to assign lines using a long jumper. Check with the line and number staff organization in the service provider for more information concerning *COSMIC*® frames and short jumper concepts.

15.2.3.3.4 Packet Switch Unit (PSU)

This section identifies the questions to ask to determine the configuration of the PSU and where to find the answers.

(1) How many shelves are equipped?

The Packet Switch Unit (PSU) may be equipped with five shelves. The PSU shelves are numbered 0 through 4. It is not necessary to equip all the shelves in the PSU. The number of shelves equipped in the PSU can be found on the ISDN SM NO. 1 page of the ISA report. The symbol to look for is as follows:

PSUSHVS NO. PSU SHELVES IN THE ISDN SM **Item N**

Item L indicates the actual PSU Shelf number to be equipped.

Other methods to obtain the number of equipped PSU shelves are as follows:

ODA	eqpsu	Used to define the equipped Packet Switch Unit shelves.
RC/V	22.3	Same as ODA eqpsu
Office Records	Form 5941	Same as ODA eqpsu

(2) How many PHs are equipped per shelf?

A PSU shelf may be equipped with up to 16 PHs. The PHs are engineered for specific functions such as Access PHs (PPB, ODB, and PPD), IP, ISM, PRI, and trunking for XAT, X.75, and X.75. The PH should be used for the function the traffic engineer specified on the ISA report. When capacity issues warrant the reallocation of the PH function, the traffic engineer must be consulted.

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The B-PHs are engineered for assignment of 64 Kbps B-channels with X.25 packet switching. Also, PHs for any D-channels with greater than 8 dpps are engineered as B-PHs. The D-PHs are engineered for D-channels with less than 8 dpps and D-channels providing Q.931 signaling.

The ISM PHs are dedicated for packet links between SMs. The interswitch packet trunk (ISPT) PHs are dedicated to trunks between the *5ESS*® switch and the public packet network switch. spare PHs are reserved for maintenance and reliability functions. The OFFICE TOTALS page of the ISA report provides the number of trunks, XAT channels, and PRIs the office was engineered to handle. Each of the X.75, X.75´, IP, XAT, and PRI requires a protocol handler assignment. Look for the following symbols in DOPSMOD:

PRI	NO. OF PRI D CHANNELS	
XAT	NO. OF XAT CHANNELS	
IP	NO. OF IP TRUNKS	**Item O**
X75	NO. OF X75 TRUNKS	
X75P	NO. OF X75´ TRUNKS	

The TRUNK/CHANNEL PROTOCOL HANDLER ASSIGNMENTS page of the ISA Report indicates the number of PHs engineered for the "trunking" types and the PSU shelf where they are to be located (**Item P**). It is extremely important to allocate the PHs by type and PSU Shelf assignment since other resources may be used such as nailed-up time slots.

The PROTOCOL HANDLER ASSIGNMENTS page of the ISA report indicates the number of PHs engineered for Access (voice and packet services assigned to BRI/DSLs) and Interswitch Module Links (ISM) (**Item Q**).

The *5ESS*® switch requires a spare PH on each shelf of the PSU. Each PH type (PH2 ,PH3 or PH4) allocation requires a spare PH on each PSU shelf. So, if your office has a mixture of PH2, PH3s or PH4s on the same shelf, it is mandatory to have 2 spare PHs, one for the PH2 one for the PH3 and one for the PH4. It is possible to allocate up to 8 spare PHs on the PSU shelf. The OFFICE TOTALS page of the ISA report allocates the number of spare PHs for the office. Look for the following symbols:

PH2SPR	NO. SPARE PH2 / PSU SHELF	**Item R**
PH3SPR	NO. SPARE PH3 / PSU SHELF	
PH4SPR	NO.SPARE PH4 / PSU SHELF	

Other methods to obtain number of equipped Protocol Handlers per PSU Shelf are as follows:

ODA	eqpsuph	Used to define the equipped Packet Switch Unit protocol handlers.
RC/V	22.16	Same as ODA eqpsu
Office Records	Form 5742	Same as ODA eqpsu

15.2.3.3.4.1 PH Requirements

The engineering algorithms assume that all packet D-channels use one quarter of a time slot, resulting in loads less than 8 dpps. In some instances, the engineering can be made to accommodate high-usage D-channels by defining extra B-channels to the engineering system. When this is done, the number of PHs ordered is correct; however, their allocation is not accurate. Although the engineering labels them as B-channel PHs, the number of PHs engineered for high-usage D-channels must be defined in your line assignment system as D-PHs. Consult your traffic engineer to determine the accurate allocation for the PHs.

There are multiple B-channels per PH. Consult your equipment engineer to determine whether multiple B-channels are assigned to a PH. The *5ESS*® switch will only allow up to 32 B-channels per PH to be assigned.

15.2.3.3.5 Packet Switch Unit (PSU) to Time Slot Interchanger Unit (TSIU) Time Slots

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The PSU is equipped with a PIDB connection from each PSU shelf to the TSIU. Each PSU shelf has a capacity of 32 time slots that are traffic engineered for XAT, X.75, X.75´ PRI, RPA/RPM, RISLU, ISM,IP and CDMA (**Item S**). The DFMP Feature has a PSU shelf capacity of 128 time slots. For further information on DFMP, refer to section 15.2.2.2 . It is imperative to monitor the allocation of these time slots since the capacity can easily be reached. Contact the traffic engineer with questions on allocation of these time slots or when you reach 90 percent capacity of the available 32 time slots. Refer to Recent Change View 22.2 to get the actual capacity count.

15.2.3.4 Loading Plan

Once the administrator knows what the office is forecasted to grow, and knows the configuration of the equipment that was engineered, as well as the capacity of the units provided, a loading plan should be established.

The first step is to designate the PH by type (that is, B, ODB, D-channel, ISM, ISPT, PRI, or spare). The service provider traffic engineer should provide this information to the administrator. ISDN must be assigned or loaded the way it was engineered to be assigned or loaded!

The next step is to establish circuit service bands and packet service bands.

NOTE: New bands may be required for Multipoint and ACD/BRCS for heavier usage BRI/DSLs. This concept is similar to CCS/Class of Service.

15.2.3.4.1 Circuit-Switched Service Bands

The circuit-switched service bands (CSB) are arbitrary groupings of customer lines, which must be defined by the service provider. These can be based on CCS ranges (that is, high, medium, low) or on specific applications (that is, host computer access, centrex attendant, or secretarial line ACD/BRCS).

A CSB is defined by its maximum usage in CCS.

When determining the service bands for your office, 9(initially and after cutover) consult with the traffic engineer to determine the weighted average CCS (obtain from the ISA Office Totals Report symbols CCSPTSM) and the data (that is, number of BRI/DSLs, average voice CCS, and average data CCS) used to engineer the office. Also consult with marketing personnel to determine if this office has unique or heavy traffic applications. Other resources are service planning organizations and other network administration organizations.

NOTE: Once the office is cutover, utilize Traffic 30 Section 77 to study the BRI/DSLs for performing CCS/CS studies.

15.2.3.4.1.1 Example CSB Service Bands

Assume that the office in question was engineered to a high-day weighted average of 8 CCS per main station, and the following data was used to establish the high-day weighted average:

10,000	BRI/DSLs (including)	8CCS*10.000 Lines = 80,000 CCS
5,000	data BRI/DSLs @ 10 CCS	10 CCS x 5,000 Lines = 50,000 CCS
500	computer ports @ 36 CCS	36 CCS x 500 Lines = 18,000 CCS
4,500	voice BRI/DSLs @ 2.6 CCS	2.6 CCS x 4,500 Lines = 11,700 CCS
TOTAL	-	- 79,700 CCS

One possible set of bands and corresponding CCS per band could be as follows:

Data	10 CCS
Computer	36 CCS
Voice	2.6 CCS
NONE (packet service only)	0 CCS

Remember that the service bands are arbitrary; different sets may be appropriate for different offices. The

goal is to make assignments that distribute the load in a way that approximates the high-day weighted average used to engineer the office. A simple check is to determine the number of lines in each band and calculate the high-day weighted average for the office. If the high-day weighted average is about equal to the high-day weighted average CCS used by the traffic engineer, the bands are appropriate. If the bands are not appropriate, the engineered number of terminations may not be achievable, or service may be degraded.

15.2.3.4.2 Packet Service Bands

The packet service bands (PSB) are a unit of packet switching demand allocation to the switch. It is similar to the idea of usage (CCS) bands in the analog world, but is more complicated.

The PH administration method uses arbitrary groupings of subscriber packet-switched lines called PSBs that are to be evenly distributed across the PHs. They are characterized by service on the same channel (B or D) and by similar packet throughput requirements. These bands are defined by the telephone company before beginning the PH assignment procedures.

15.2.3.4.2.1 Logical Channels

A B-channel is limited to a maximum of 128 logical channels and virtual channels for a PH2, and D-channels are limited to a maximum of 16 logical channels. In each case, 1 logical channel is reserved for signaling. A PH may have a maximum of 128 logical channels active at one time. A PH3 may also have 128 active at one time, but also has a virtual capacity of 255 channels. Each logical channel active per BRI/DSL generates additional usage (dpps).

15.2.3.4.3 Packet Service Band Implementation

A packet service band implementation (PSB) is defined by its usage (PH load), the time slot weight, and the number of logical channels allowed (concurrent packet calls). In addition, a PSB can limit the number of D- or B-channels with this PSB that are assigned to a single PH (MAX. PSB per PH).

Each PSB must have a unique name, PSBs band the usage (dpps) of an individual B-channel with X.25 service an individual D-channel with X.25 service. PSBs should be created for each service with more than one logical channel assigned as signaling only or, as stated above, B-channels may have up to 127 channels assigned and active. D-channels may have up to 15 assigned and active. The more channels assigned and active on a BRI/DSL, the higher the usage (dpps) generated. Multipoint BRI/DSLs may have up to 8 users sharing the D-channel (i.e., the more users, the more usage generated). PSBs should be created for each Multipoint BRI/DSL service offering.

The Z-cards do not have PSBs. The B-channels without packet switching service do not have PSBs, and D-channels without X.25 (doing Q.931 signaling protocol only) must have the PSB described previously.

Table 15.2-19 summarizes the relationship between channel configuration, service bands and PSBs (with N/A indicating not applicable).

Table 15.2-19 Channel Configuration and Service Band Relationships

CONFIGURATION	CSB	PSB
BRI/DSL (2B+D) (signaling only)	Always Always	
BRI/DSL (2B+D)	Always [a]	
B w/X.25	N/A	Yes
B w/o X.25	N/A	No
D w/o X.25	N/A	Always
D w/ X.25	N/A	Yes
Z Card	Always	N/A
Notes:		
a. If no circuit-switched service is assigned to a BRI/DSL, it should have a service name = None and service usage = 0.		

15.2.3.4.3.1 PH Load Determination

When determining the PSBs for your office, consult with the traffic engineer to determine the high-day weighted average dpps and the number of B-channels, number of D-channels, average dpps per B-channel, and average dpps per D-channel used to engineer the office. Also consult with marketing personnel to determine if this office has any unique or heavy packet traffic applications.

Engineering algorithms do not support D-channel engineering in the range of 9.25 dpps to 36.99 dpps, PSBs for D-channels should not have PH load values in this range. This restriction arises from the engineering assumption that 4 D-channels are always multiplexed into one time slot. The PH loads in the range of 9.25 dpps to 36.99 dpps result in situations where less than four D-channels are in 1 time slot because a time slot can route to only 1 PH and less than 4 D-channels may be assigned to that PH. The consequence is that the D-channels use more than the designed number of time slots when the ISLUs are assigned to terminal capacity. The extra time slots are taken from the pool of time slots used for circuit switching, thus reducing the circuit-switched capacity of the unit.

15.2.3.4.3.2 Time-Slot Weight Determination

Every PSB must have a time-slot weight. If X is the PH load for the PSB, the time-slot weight is determined as shown in Table 15.2-20 for D-channels.

Table 15.2-20 PSB Time-Slot Weight Determination

PPS/CHANNEL	TIME-SLOT WEIGHT
X < = 9.25	0.25
8 < x < = 12.2	0.33
10.7 < x <=18.5	0.50
16 < x <=37	1

The B-channels always require a whole time slot (time-slot weight = 1) because of their 64 Kbps bandwidth. The D-channels providing Q.931 signaling only always require a quarter time slot.

Your line assignment system should use the time-slot weight to ensure that the time slot allocation for each LGC, DPIDB, and PSU shelf matches allocation by software in the switch.

15.2.3.4.3.3 Logical Channel Requirements

A B-channel can have up to 128 logical channels (one of which is reserved for signaling), and a D-channel can have up to 16 logical channels (one of which is also reserved for signaling). Since the number of logical channels a customer has is a subscription parameter, check with your marketing or service planning organizations to determine the correct number of logical channels for each PSB.

The PH software has the capacity to serve 128 "active" logical channels. Your line assignment system should count the number of logical channels assigned to a PH, and stop assigning lines to that PH when the 128 limit is reached. Therefore, a PH could be assignment limited because of the number of active logical channels. Your line assignment system should use logical channels as a secondary parameter in determining the least loaded PH to assign. The primary parameter is the packet usage (dpps); however, to avoid low PH use, the number of logical channels should be accurately reflected or defaulted to a value of 1 [a value of 1 allows all 128 ports on a PH to be assigned, providing the PH capacity limit (50 dpps in PH2 or 200 dpps in PH3) is not exceeded].

15.2.3.4.3.4 MAX PSB Per PH Determination

The MAX PSB per PH is used to limit the number of lines with a particular PSB that are assigned to a PH. For example, if the service provider wished to limit host computer ports to one per PH because of potential heavy usage, this parameter should be set to one.

15.2.3.4.3.5 Example PSBs

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For an example, assume that the office in question was engineered to a weighted average of 0.5 dpps per D-channel. There are a total of 10,000 BRI/DSLs including the following:

25	B-channel packet	25 * 32 PPS = 800 PPS
10,000	BRI/DSLs (including)	10,000 * .5 PPS = 5000 PPS
4,400	D-channel packet	4,000 * .6 PPS = 2640 PPS
5,000	circuit-switched only	5,000 * .1 PPS = 500 PPS
75	computer ports (D-channel).	75 * 8 PPS = 600 PPS
TOTAL	-	- 3740 PPS

One possible set of PSBs is shown in Table 15.2-21 .

Table 15.2-21 Example of Packet Service Bands

BAND	PH LOAD	TIME-SLOT WEIGHT	MAX PSBs/PH	LOG. CHAN.
B-channel	37	1	1	1
D-channel	0.75	0.25	42	1
Computer	22.6	1	1	16
Q.931	0	0.25	128	0

Remember that PSBs are arbitrary, so different sets may be appropriate for different offices. However, to determine if a set of PSBs is appropriate for an office, determine the number of channels in each PSB and calculate the weighted average dpps. If this is about equal to the weighted average dpps used by the traffic engineer (obtain from ISA Office Totals Report symbol DPPS), the bands are appropriate.

15.2.3.4.4 ISM Link Assignment

When the *5ESS*® switch is configured to have more than one SM with the ISDN feature, nailed-up time slots are used to provide the communications path between SMs. These nailed-up time slots are referred to as ISM links. These links terminate on a PH that is dedicated to ISM traffic. The quantity of links (that is, time slots) and the quantity of ISM PHs required in an SM are traffic engineered. To activate an ISM link, the near-end PH and port assignment [referred to as the integrated services channel number (ISCN) by recent change] and the far-end PH and port assignment must be defined in the office dependent data (ODD) for each SM. To define a link between two SMs, it is necessary to do a recent change in each SM.

15.2.3.4.4.1 Engineering Interfaces

Because the number of links and the number of ISM PHs required in each SM are engineered, the administrator needs to obtain this information from the engineer for the site being translated.

15.2.3.4.4.2 Calculating ISM Links Per SM Pair

The engineering rules for ISM links calculate the basic connectivity required between all ISDN SMs. (The DOPSMOD calculates the number of links to interconnect only the SMs engineered in the same run. If the office is engineered in communities of interest, an ISM network is calculated for only that community. If interconnection of these networks is desired, manual adjustments must be made in every ISDN SM in each network. If RSMs and ORMs are to be connected to a network, manual adjustments are required in the remotes and in each ISDN SM to which the remotes connect.) To assign the ISM links it is necessary to determine the number of links between each pair of SMs. The ISM links are translated in SM pairs to ensure that the number of links leaving one SM matches the number of links terminated in the far SM.

15.2.3.4.4.3 Calculating PHs Per ISM Link

The ISM links should be spread across ISM PHs. A link may terminate on only one ISM PH, and multiple links in the same route should be assigned to different ISM PHs. The methodology presented here uses the quantity "ISM PHs per link" to determine the order of assignment. Since a link can terminate on only one ISM PH, this quantity will always be less than or equal to one. Also, the sum of the values for "ISM PH/LINK" for all the links assigned to a single ISM PH must be less than or equal to one.

To determine the ISM PH/LINK, divide the number of ISM PHs per SM pair by the number of ISM links per

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SM pair. (The DOPSMOD system does not report the ISM PHs on a per pair basis; therefore, the number of ISM PHs for a pair of SMs must be assumed.)

15.2.3.5 Assignment Guidelines

This section presents some examples of BRI/DSL assignments and gives some of the restrictions for assignments. This is not a comprehensive listing of restrictions.

NOTE: Lucent Technologies is removing the recommendation of segregating assignments of PHs by SM component (ISLU, RISLU, IDCU, ISLU2, AIU, and TR-303 on DNU-S). ISDN customers use the same applications whether the lines terminate in an ISLU, ISLU2, IDCU, etc. The DDPS inputs to 5 DOPSMOD should be obtained from TRFC30 Section 68. Traffic engineers may use the same DPPS entries for each SM component based on actual data or estimated PPS based on specific customer's needs.

In addition to removing the recommendation of segregating assignments of SM component, it is possible to mix Permanent Packet B-Channels with D-Channel Packet and Access Digital Service Lines. To accomplish the required DPPS entries for 5 DOPSMOD, utilize the DPPS from TRFC30 Section 68 from the "Access PHs" as a guideline for forecasting future packet demand.

15.2.3.5.1 Order of Assignment

Before assigning BRI/DSLs, it is important to assign spare PHs and dedicated PHs (ISM, ISPT, SPARE, PRI) via recent change on the *5ESS*® switch. (Spare PHs are translated as a quantity per shelf. There is no unique PH number and port assigned by the administrator.) Access PHs should be assigned by your line assignment system, observing the following guidelines.

(1) Assign all packet B-channels first. Allocate equipment by class of service and reserve the engineered quantity for assignments. The PHs chosen should be blocked from further assignments for other than B Channel assignments if you choose not to mix B and D Channel PH assignment.

(2) Next, assign high-usage D-channels. If necessary, use the preassignment option to reserve the engineered quantity of assignments. The PHs chosen should be blocked from further assignments. for other than B Channel assignments if you choose not to mix B and D Channel PH assignments.

(3) Assign all packet-only BRI/DSLs.

(4) Assign all ISDN attendant positions.

(5) Assign all ACD/BRCS

(6) Assign Application Processor (AP) links.

(7) Assign BRI/DSLs requiring special segregation.

(8) Assign the remaining BRI/DSLs with X.25 packet service and Z-cards beginning with the highest usage lines.

(9) Assign the remaining BRI/DSL and Z-cards. If you wish to backfill the PHs assigned in the first two steps, remove the blocked status. (Backfilling is only permitted when PSB "Q" is used and its PHLOAD is zero.)

15.2.3.5.2 Assignment Communities

Some features (BRCS, shared DN, AP links) have operational advantages or memory savings if they are assigned judiciously. Also, certain hardware configurations such as optically remoted module (ORM), remote switching module (RSM), and RISLU define separate communities. One way to achieve separate

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communities is to maintain separate data bases for each community. This works well for the hardware communities since they are usually separate office identifications (IDs), but is not efficient for communities defined via feature content.

A feature that requires segregation of lines to a minimum number of SMs can be handled by blocking assignments to all SMs except the desired SMs. Then the lines can be assigned, and the restriction removed after all the lines in the community have been assigned. Similarly, packet features can be segregated by blocking all PHs except the desired PHs.

Early office applications need to perform manual checks to assure proper feature segregation.

15.2.3.5.3 Manual Checks

The following segregation rule should be checked.

- AP Links: There should be no more than 16 AP links per SM. Also no more than ten different APs should have AP links assigned to the same SM. All links from a single AP must terminate on the same SM.

- Attendant Console: The attendant console is an SM real-time intensive line and should be evenly spread across the office (do not segregate) so as to have the minimum number possible per SM. If ISDN busy monitor and attendant features are employed, the station spreading should be limited to 13 SMs.

- IDP, Automatic Route Selection (ARS), Uniform Numbering Plan (UNP) and Configuration Groups: The listed features are memory intensive and may need to be segregated. Consult with your traffic engineer and equipment engineer to determine if special administration has been assumed in the engineering. There are no *5ESS*® switch requirements for special handling of these features, but SM memory can be configured, at the service provider's option, in a way that may cause assignment restrictions.

15.2.3.6 ISLU Load Balance

The following key indicators are important to ensure that the ISLUs remain in proper balance. The following list contains key items to monitor after loading the ISLU:

- Check for set up delay (analogous to dial tone delay for analog lines) [TRFC30, Section 53] for U- and T-cards; check for dial tone delay (Section 4) for Z-cards, and terminating blockage (TRFC30 Section 49). Log the terminating blockage and dial tone speed delay (or set up delay) to identify if blockage is occurring.

  In the ISLU, blockage may occur at either the PIDB or LIDB buses for circuit-switched voice or data or the DPIDB for On-Demand B set up. Blockage in the PIDB occurs when all the PIDB time slots are being used. To avoid such blockage, it is important to ensure that the usage in the ISLU has not exceeded its capacity which is determined by the number of PIDBs installed. Furthermore, the total CCS load should be distributed as evenly as possible across all ISLUs. In this way, unit-to-unit variations are minimized. An LIDB blockage occurs when there are too many X.25 (including ODB) assignments in an LGC. A DPIDB blockage can occur when the time slots allocated for ODB have been exceeded. If time slot blockage occurs, measurements on a per LGC basis (TRFC30 Section 145) or measurements on individual BRI/DSLs in an ISLU (TRFC30 Section 107 or Section 77 in Software release 5E10 and later) can be used to more precisely isolate the problem.

- The switch administrator should monitor the ISLU (TRFC30 Section 49 and 145) data to ensure that the ISLUs are not loaded above the desired capacity level. Daily busy-hour measurements can be compiled to monitor the load balance.

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- For situations with high dial tone delay (set up delay) and low terminating blocking, check the occupancy of the switch module processors (SMPs). Half-hour occupancy readings higher than 70 percent (TRFC30, Section 15) for SMP may mean that the SMP is being overloaded under peak calling conditions. Such overloads may produce customer complaints of terminating blocking and slow dial tone.

  Also check the TRFC30 reports for out of service (Maintenance Usage) equipment which may cause line origination problems.

- If assignment systems are used, make sure that the CCS/class of service parameters that provide load-directed assignments accurately reflect customer calling usage.

- Inhibit new assignments into the SMs with consistently high CCS, dial tone (Z-cards) delay, set up delay, and terminating blockage.

- To ensure that one ISLU is not used constantly for assignment thus causing it to overload or block consistently, update the USAGE status for each ISLU into the line assignment system.

- The ISLU digital subscriber line measurements (TRFC30, Section 107, or Section 77 in 5E10 and later) may be used to identify high usage customers. Activate Section 107 (or 77 in 5E10 and later) on both high and low usage ISLUs to move high usage lines from one ISLU LGC to a low usage ISLU LGC.

- The LU/ISLU load administration measurements feature can be used to monitor ISLU LGC. Section 145 of the TRFC30 report provides usage counts based on a 100 second scan for each LGC for up to 4000 LGCs. This measurement allows the administrator to perform load administration of the ISLUs.

- Set up weekly studies using TRFC30 Section 145 data. Collect the data for all the ISLUs in the office or for a certain number of ISLUs because no more than 4,000 LGCs can be studied at a time (A maximum of 250 ISLUs with 16 LGCs each). Data collection should include the busy hour of each day of the week or, if the busy hour is not known, the collection of data should include every half-hour data to validate the busy hour. After the data is collected, analyze Section 145 data using the following balancing process

  The maximum value for an LGC depends on the number of nailed-up time slots (PPB-channels). This number can vary from one LGC to another. A PPB nailup uses a dedicated time slot on the LIDB, thereby reducing the number of time slots available for CS calls. This affects the maximum value of the usage traffic count in Section 145.

Time slot contention is an issue for circuit-switching and is the basis for concentration in the ISLU. The 3 units where time slot contention occurs are LIDB TSs, PIDB TSs, and TSI TSs. To determine the maximum LGC capacity, it is necessary to obtain the following information:

- The number of PIDBs connected from the TSI to each ISLU

- The number of ODB and PPB assigned to each LGC in each ISLU.

The number of PIDBs to the ISLU determines the circuit switch capacity of the ISLU by the following formula:
Number of PIDBS □ 32 TSs □ 18 [30 Min CCS/TS] □ .45 [% OCC]

= ISLU CS Capacity

ex: 4 PIDBs □ 32 □ 18 □ .45 =1036.8 CCS

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Since there can only be up to 16 PIDBs engineered to an ISLU, Table 15.2-22 lists the ISLU capacity for up to 16 PIDBs.

Table 15.2-22 ISLU Capacity (CCS/Half-Hour) and LGC Circuit-Switched Capacity

NO. OF PIDBs	NO. OF TSs AVAIL.	ISLU CAP. (30 MIN). CCS	LGC CS CCS CAPACITY [30 MIN] PER PIDB							
			LGC 2	LGC 3	LGC 6	LGC 8	LGC 10	LGC 12	LGC 14	LGC 16
2	64	518.4	259.2	129.6	86.4	64.8	51.8	43.2	37.0	32.4
4	128	1036.8	324.0	259.2	172.8	129.6	103.7	86.4	74.1	64.8
6	192	1555.2	324.0	324.0	259.2	194.4	155.5	129.6	111.1	97.2
8	256	2073.6	324.0	324.0	324.0	259.2	207.4	172.8	148.1	129.6
10	320	2592.0	324.0	324.0	324.0	324.0	259.2	216.0	185.1	162.0
12	384	3110.4	324.0	324.0	324.0	324.0	311.0	259.2	222.2	194.4
14	448	3628.8	324.0	324.0	324.0	324.0	324.0	302.4	259.2	226.8
16	512	4147.2	324.0	324.0	324.0	324.0	324.0	324.0	296.2	259.2

Next, take the ISLU capacity and divide by the number of LGC equipped in the ISLU. Table 15.2-22 also includes the LGC capacity for the number of LGC equipped vs. the number of PIDBs equipped.

NOTE: The CS capacity of the LIDB is only 324 CCS/ half hour.

44 TSs □ 18 CCS □ 0.4091 (% OCC) = 324 CCS

Thus if we divide the ISLU CS CCS capacity by the number of LGC and the result is higher than 324, then the LIDB is the limiting item and we use the 324 CCS value.

The maximum CCS load for the LIDB or LGC is 324 whether the traffic is for packet switching or circuit switching. From the LGC capacity table, if the LGC capacity is less than 324 CCS the circuit switch CCS capacity noted previously should not be exceeded; however, the packet switched CCS can occupy the difference. For example, an ISLU has 10 PIDBs and 16 LGCs, so from Table 15.2-22 , the LGC circuit switch capacity is 162.0. Since the MAX capacity of the LGC is 324 CCS, then 324.0 - 162.0 = 162.0 CCS is available CCS for packet switched traffic. The number of PPB lines and ODB reduce the CCS capacity per LGC. See section 15.2.1.1.2 .

TRFC30 Section 145 reports the usage for both circuit switch and packet switch traffic, so to determine how much circuit switch CCS is being used, the administrator will have to subtract the packet switch usage. To subtract out packet switch usage, determine the amount of B-channel X.25 users assigned to an LGC. Use this number to compare with the

Section 145 will be output to the EADAS channel. Once Section 145 is activated, raw traffic data on usage is sent directly to EADAS, when requested, at the end of every 30 minutes. From EADAS, only selected data is sent to other down stream processors for load balancing. The tables above should be used as guidelines for flagging a particular LGC.

15.2.3.7 PSU Load Balance

The following list contains key items to monitor after loading the PSU:

- A difference exists between the packet- and circuit-switched networks in that the packet network is nonblocking. Instead, the user experiences poorer performance during overload conditions. These performance degradations are usually manifested in longer file transfer times and real-time breaks during display functions. To ensure good packet-switching service, it is necessary to evenly distribute the packet load across the PHs, and to operate the PH within its packets per second capacity or throughput limitations.

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Monitor TRFC30, Sections 52 and 68 for each PH's packet per second. If the throughput of the PH is exceeded, then use TRFC30 Section 67 to determine the high packet users in the PH and move the assignment to a lower packet usage PH.

15.2.4 ISDN APPLICATION PROCESSOR LINK ASSIGNMENT GUIDELINES

15.2.4.1 Application Processor Feature Description

An application processor (AP) is connected to the *5ESS*® switch by a 9.6-Kbps data link. The AP is connected via an ISDN BRI/DSL. This description addresses the ISDN BRI/DSL.

Lucent Technologies offers an advanced communications package (ACP) that is a set of software modules that runs on an AP. The feature software is based on a modular design, which means that each feature can be loaded as a separate entity and is basically independent of any other feature. Many of the ACP features receive data, such as Customer Message Service System (CMSS), Electronic Directory Service (EDS), advanced station message detail recording (ASMDR), Facilities Management System (FMS), Traffic Data System (TDS), and Automatic Circuit Assurance (ACA), from a *5ESS*® switch.

15.2.4.2 *5ESS*® Switch Communications Interface

The AP communicates with a *5ESS*® switch equipped with ISDN over a BRI/DSL line that interfaces with a switching module (SM) equipped with an intergrated services line unit (ISLU). This is shown in Figure 15.2-13 .

Figure 15.2-13 Application Processor Interface

The BRI/DSL uses an X.25 Link Access Procedure - D channel (LAPD) protocol and connects to the 7A Direct ISDN Interface (DISDNI) unit that is usually co-located with and connected to the AP. The connection from the *5ESS*® switch to the 7A DISDNI unit may, depending on the distance, be via a T-card interface, a U-card interface, or a U-card and a basic rate interface transmission extension (BRITE) card.

15.2.4.3 Engineering Issues

API links are connected to the *5ESS*® switch via a T-card, a U-card, or a BRITE card. The traffic engineer must provide the correct quantity of cards based on the interface to be used.

The *5ESS*® switch also requires a protocol handler (PH) channel assigned to each link, so the traffic engineer must provide the correct quantity of PHs.

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15.2.4.4 Administration Issues

Although the purpose of this section is not to engineer an AP, it is important to know engineering inputs to adequately perform administration functions. The communication links (API links) and the cards (U and T) have impact on the switch.

Administration issues for the switch are capacity on the PHs for the API links and terminations (cards and PH channels).

Assignments of API links and BRI/DSL lines can be mixed within ISLUs and PHs. The administrator may want to define a packet service band to reflect the anticipated usage of the link.

Although there are no restrictions to the number of API links that can be assigned to a PH, API link assignments should be spread evenly over the PHs. Also, the links should be assigned to different PHs for reliability (an AP requires a minimum of two links).

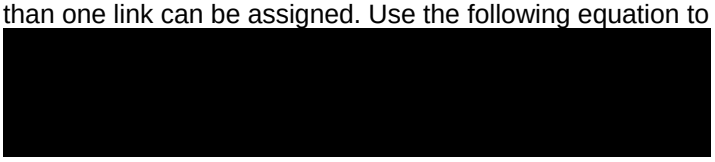
The switch administrator should monitor usage on the API links by activating a special study on TRFC30 report section 67. This section provides usage on the individual channel of the PH. Since the API links are assigned to access D-channel PHs, total PH usage should be monitored to provide good service to all customers.

Based on services that originate as voice calls and access the AP, such as the CMSS Deluxe Services, circuit switched usage occurs while the call is in progress. The administrator monitors ILSU usage on TRFC30 section 52

In summary, once the AP services are established, activate a special study to monitor customer usage on the links, then adjust the packet service band accordingly. Monitor the total PH usage on TRFC30 section 68. Refer to 235-600-750 *Output Messages Manual* to view a TRFC30 Section 68 report.

The following procedures and guidelines should be used to load AP links onto PHs:

- Based on traffic engineering, determine how many links are to be assigned and what the anticipated usage per link is.
- Once the anticipated usage has been determined, assign the link. The API links require a line card equipment number (LCEN), either U- or T-cards may be used, and a D-channel integrated services channel number (D ISCN).
- Monitor the usage to verify that the anticipated usage agrees with the engineered usage. When the actual usage has been monitored, more links and lines can be assigned to the PH. It is recommended to assign one AP link to the PH until usage in data packets per second (DPPS) indicates that more than one link can be assigned. Use the following equation to find the DPPS:



- BRI/DSLs and AP links can be assigned to the same PHs.
- Usage for all PHs should be continuously monitored.

15.2.5 ASSOCIATED MEASUREMENTS AND KEY SERVICE INDICATORS

There are many sections of the TRFC30 report containing measurements directly related to ISDN. These sections are listed below and described in detail in 235-600-750 Output Messages Manual.

Measurements play a critical role in any major endeavor. The measurements provided for ISDN are the

same basic measurements provided in the TRFC30 including peg counts, usages, and overflows. The difference in the measurements is the unit the measurement is being taken against and how it is being captured. For example, to measure the delay a customer may experience while attempting to initiate a call, dial tone delay is used for an analog line unit. Since the ISLU uses the D-channel signaling for circuit-switched calls, any delay found in receiving a set up message is the source for the measurement. Both measurements are pegged if the customer waits more than 3 seconds for the sign that they can input the digits for the call.

To support ISDN, 14 sections have been added to the TRFC30 report.

- Section 49 - ISLU
- Section 50 - ISDN office totals
- Section 51 - ISDN packet interface measurements
- Section 52 - ISDN digital subscriber line group
- Section 53 - ISDN SM measurements
- Section 67 - ISDN PH ports
- Section 68 - ISDN packet switching PH/DSLG
- Section 69 - ISDN packet switching office totals
- Section 71 - ISDN packet switching group counts
- Section 92 - Packet switching trunk group
- Section 105 - On-demand B-channel
- Section 106 - Packet switching directly connected PIDB
- Section 77 - Digital subscriber line measurements
- Section 119 - Packet Business Groups
- Section 145 - Line Group Controller Measurements.

To support ISDN BRCS, 6 sections have been added to the TRFC30 report and existing Section 59 in the TRFC30 was altered to include measurements on the application processor connected over a BRI/DSL.

- Section 59 - Application processor data link measurements
- Section 72 - ISDN BRCS office totals
- Section 73 - ISDN BRCS electronic directory service
- Section 74 - ISDN BRCS message service customer
- Section 75 - ISDN BRCS message service multiline hunt group
- Section 108 - Automatic customer station rearrangement.

These sections may be viewed on the ROP or transmitted to an operational support system just as existing sections. The input command ``ALW'' allows the user to activate the desired section for collection. More information on the ``ALW'' command can be found in 235-600-700 under ALW:TRFC30.

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The format of the ISDN measurements is set up like the analog measurements. The ISDN measurements can be conceptually broken up into circuit-switched data measurements, packet-switched data measurements, and the ISDN BRCS measurements. The ISLU section contains the same types of counts as in the LU Section 11. Usage for circuit-switched calls is measured in CCS and is performed by scanning as in analog calls. Usage for packet-switched data is measured in data packets per second (dpps). Overflows and attempts are measured like peg counts. An ISDN office totals section exists which mirrors Section 3, Office Totals. Note that Section 3 contains the combination of both analog and ISDN measurements for the entire office.

Section 67 is a special study section which can be set up through Recent Change and allows the user to look at a particular PH and all the associated ports on that PH. This section gives the detail at a subscriber level on the ISDN customer.

15.2.5.1 Maintaining Load Balance

When loading is completed, monitor the office closely for changes in the growth pattern or increased CCS/network access lines (NAL) and ensure the load is spread over all the ISLUs. A good class of service spread provides better use of the equipment and better customer service.

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15.3 REMOTE INTEGRATED SERVICES LINE UNIT

15.3.1 DESCRIPTION

15.3.1.1 Universal RISLU

A Universal Remote Integrated Service Line Unit (RISLU) is a line unit that can be remoted up to 175 miles from the host. Typical applications for a RISLU include pair gain system, small community dial office (CDO) replacement, private branch exchanges (PBX) replacement, the introduction of ISDN in non-ISDN exchanges, and provide ISDN services beyond the loop requirements.

The RISLU is an ISLU that can be remoted from the host *5ESS*® switch via pulse code modulation (PCM) carrier facilities. The hardware in the host switching module (SM) converts data on the peripheral interface data buses (PIDBs) and control information on the peripheral interface control bus (PICBs) into PCM carrier format. The synchronization signals at the RISLU are derived from the incoming data stream, and a remote clock is provided in the RISLU to maintain critical timing.

15.3.1.2 Enhanced RISLU

The enhanced RISLU (ERISLU) combines the features of the ACD/OSPS RISLU and Universal RISLU. The ERISLU supports the full integration of ACD and the MIS with ISDN BRCS functions. In addition, the ERISLU also provides environmental office alarms, on a site-by-site basis. The following points are emphasized for clarity:

- The remote alarm section (RAS), used for environmental alarm units equipage is optional. The unit can be added using the RAS growth procedure.
- When an ACD/OSPS RISLU is equipped with an RAS and is converted to an ERISLU, the resulting ERISLU will be equipped with the RAS after the conversion.
- The conversion of ACD/OSPS RISLUs to ERISLUs requires that all DFI-Hs assigned to the RISLU must be placed OOS. There must also be a static data change, and a full initialization of the host SM.
- The Universal RISLU can be converted to an ERISLU.
- ERISLU will not support the hot spare strategy.
- The RAS requires a T-line card as a data link to interface to the SM.
- The ERISLU can support a mixture of U, T, and Z-cards on the same line group controller without affecting call quality.
- The ERISLU may exist on the position SM and the loaded SM.
- The conversion from ERISLU to ACD/OSPS RISLU is not supported.

15.3.1.3 RISLU on SM-2000

The ISDN on the SM-2000 feature integrates additional features and functionality found on SMs, such as ISDN, onto the SM-2000 platform. With ISDN comes the need to supply an Integrated Services Line Unit (ISLU) vehicle to provide end users with ISDN service. In the 5E10 software release, to provide Integrated Services Line Units on SM-2000, the existing RISLU and RISLU2 are ported from the SMs to the SM-2000. The major improvement of the RISLU2 over the RISLU is its potential for increased line capacities.

The RISLU2 uses *FASTECH* ® N-sized (8.5 by 13 inch) circuit packs with eight or sixteen line circuits on

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each line pack. The RISLU2 provides up to 1024 ISDN terminations (via T8 or U8 line packs) or up to 2048 analog terminations (via Z16 line packs). All RISLU2 terminations are subject to line traffic engineering and it is expected that on the SM/SM-2000, the RISLU2 units will typically support 768 ISDN or 1024 analog Z lines.

The RISLU2 on SM-2000 enhances services provided in ISDN in two ways. First, the RISLU2's multiple circuit line packs allows increased capacity of its U, T, and Z interfaces when compared with the RISLU's interfaces. Second, by providing the RISLU2 on the SM-2000, there will no longer be the pre 5E10 requirement to ship SMs whenever ISDN is required on the *5ESS*® switch. The RISLU2 on the SM-2000 will further the parity between the SM-2000 and the SM. Moving the SM-2000 to SM parity, means that most features and peripherals (or their functional equivalents), found on a SM, but are not currently available on the SM-2000, will be ported to the SM-2000.

15.3.1.3.1 Transparency Issues

The end users' ISDN features as provided by the RISLU2 platform are transparent to the features which were provided by the 5E9(2) RISLU platform with only three exceptions. The exceptions are that the 5E10 RISLU2 platform will not support the following:

- OSPS
- ACD/BRCS
- DSN features

Automatic Power Recovery allows the full, automatic recovery of *5ESS*® switch RISLU2 equipment after an extended commercial AC outage where the battery plant has deeply discharged. This includes the automatic restoral of the power subsystem and automatic software reinitialization after commercial power has returned. No intervention by exchange technicians at the RISLU2 site is required for full recovery. Remote alarms will be available to detect a failure in the automatic recovery hardware.

15.3.1.4 Loop Interfaces

The RISLU supports the T (4-wire) and U (2-wire) interface for ISDN BRI services. A RISLU can support up to 316 BRIs which can be a mixture of T- and U-cards. The Z-cards may also be equipped in the same RISLU with the BRI. The maximum number of cards (T, U, and Z) per RISLU is 512, but no more than 316 of these may be BRIs.

The BRI provides two B-channels which communicates digital voice or data and a single D-channel which is used for control signaling and packet-switched data. The term 2B+D is often used to define the BRI. Each B channel on the BRI has a transmission rate of 64 Kbps. The T-card provides a 4-wire BRI connection into the RISLU, with the distance between the customer terminal and the RISLU being limited, in terms of loss, to 6 dB at 96 kHz. The U-card provides a 2-wire BRI connection into the RISLU, with the distance between the customer terminal and the RISLU being limited, in terms of loss, to 32 dB at 80 kHz.

15.3.1.5 Line Group Controller

Thirty-two line cards are grouped over a common bus, called the group interface data bus (GIDB), to a controller called the line group controller (LGC) as shown in Figure 15.3-1 . Control of the line cards is maintained via two control/signaling time slots on the GIDB. The remaining 30 time slots are available for B-channel traffic and D-channels. Up to 16 LGCs may be equipped per RISLU.

15.3.1.6 Line Interface Data Bus

The line interface data bus (LIDB) pair is the output of the LGC. In the RISLU, two LIDBs are provided per LGC, and are operated in the active-standby configuration. Unlike the ISLU, which has an active-active

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configuration, the RISLU has a maximum of 30 traffic carrying time slots per LIDB pair compared to a possible 60 time slots per LIDB pair for the ISLU. As a result, the traffic capacity of a RISLUs LIDB pair is considerably less than that of the ISLUs LIDB pair. A discussion of the LIDBs capacity is included in the engineering section.

15.3.1.6.1 Common Data Boards

The common data (CD) boards terminate the LIDBs from each LGC and transfer the time slots to appropriate PIDB ports. Since the RISLU does not have directly connected PIDBs (DPIDBs), all traffic including packet-switched nail-ups leave the CD boards on PIDBs. Each PIDB leaving the CD has 23 traffic carrying time slots, 1 time slot of signaling information and 8 time slots stuffed with idle code. In addition to the PIDBs the CD has a control interface data bus (CIDB) which has the control time slot from each LIDB, and the control information for the CD boards (see Figure 15.3-2) is transferred from the LIDBs to the CIDB.

15.3.1.6.2 Common Control Board

The common control(CC) board takes the control time slots from the CIDB and converts them into PICB format.

15.3.1.6.3 Remote Digital Facility Interface

There are two types of Digital Facility Interface-Remote (DFI-Rs):

(1) The DFI-R1 converts PIDB data from the CD and PICB data from the CC into PCM carrier format. The DFI-R1 has 24 DS0 channels, but one is reserved for control and another is reserved for signaling.

(2) The DFI-R2 converts PIDB data from the CD into PCM carrier format. The DFI-R2 has 24 DS0 channels, of which one is reserved for signaling.

For normal operation, a RISLU must be equipped with two DFI-R1s. Up to ten DFI-R2s may be equipped per RISLU, with the exact quantity per RISLU being determined by traffic considerations.

In addition to terminating PIDBs and PICBs, the DFI-R1 has the ability to monitor and send four alarms; fan, fuse, power, and battery. The DFI-Rs are operated as a pair on either a clear channel facility (64 Kbps) or a nonclear channel facility. All of the DFI-Rs in a given RISLU must operate in the same mode. Clear channel facilities must have Bipolar 8 Zero Substitution (B8ZS) format, which inserts a fixed 8-bit code with bipolar violation in bit positions 4 and 7 when a string of 8 zeros is detected. Nonclear channel facilities employ Zero Code Substitution (ZCS) in which a 1 is substituted in one bit when an 8-bit pattern of zeros is encountered in the data stream. The maximum user bandwidth in this latter arrangement is 56 Kbps clear or 64 Kbps restricted.

NOTE: The ISDN circuit-switched digital capability provides circuit-switched B-channel transport between ISDN terminals at a 56 kb/s or 64 kb/s clear channel data rate. The intra-switch data rate capability depends upon the data rate capability of the host-to-RISLU transmission facilities. To provide 64 kb/s ISDN circuit switched data capability on an RISLU, the umbilical to the RISLU must support that data rate.

15.3.1.6.4 Remote Clock

There are two remote clock circuit packs provided in the RISLU which reside in the digital line trunk unit - remoting - remote end (DLTU-RR) along with the DFI-Rs. They are configured in an ACTIVE/STANDBY mode where the STANDBY side is locked to the ACTIVE side by means of a cross-couple timing signal. One of the DFI-R1 packs (Master) is in control of the RCLKs and is designated by a * on the MCC display. It is also the facility that is providing the timing reference for the RCLKs.

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15.3.1.7 T1 Facility

The T1 facility consists of all the channel service unit (DSU), repeaters, digital cross connects (DSX), and carrier terminals installed in the circuit between the RISLU and the host. For a clear channel facility, these units (if appropriate) must be optional for ZCS. All of the equipment in the facility should be optioned for "loop" timing. On each facility, channel 24 is reserved for analog signaling.

15.3.1.7.1 Host Digital Facility Interface

There are two types of digital facility interface-host (DFI-H):

(1) The DFI-H1 terminates the T1 carrier and converts the PCM carrier formatted data into PIDB and PICB format.

(2) The DFI-H2 terminates the T1 carrier and converts the PCM carrier formatted data into PIDB format.

In addition to reconstructing the PICB and PIDB format, the DFI-H1 constructs a PICB bit stream containing the alarm states, and passes this information to the switching module processor (SMP). No scan points are required in the host for these alarms.

The translations for the DFI-H/R pair defines whether the T1 facility is operated in clear channel or nonclear channel. This is accomplished via a parameter called the "DFI MODE". In addition to the DFI MODE, the translations also provide for definition of the stuffing pattern for each DFI-H/R pair.

The DFI-Hs reside in another DLTU-R that is identical to the one in the RISLU except that it does not contain RCLK boards and is equipped with DFI-Hs. The DFI-H1 and DFI-H2s are different circuit packs, and these packs are different from the DFI-R1 pack and the DFI-R2 pack. A DLTU-RH can terminate 4 type 1 packs and 12 type 2 packs. Since a RISLU only requires 2 type 1 packs, it is possible for the DLTU-R in the host to support 2 RISLUs, providing that the limit of 12 type 2 packs is not exceeded. The DFI-Hs for a given RISLU may be assigned to different data interface (DI) boards.

15.3.1.7.1.1 Stuffing Pattern Impacts

Figure 15.3-2 is a time slot map for a fully equipped RISLU having four T1 spans. As mentioned before, each LGC has two time slots for control and signaling leaving 30 time slots for traffic. Each T1 span has 24 time slots which are mapped into the PIDBs by stuffing idle code into the time slots indicated by the Xs. In the time slot interchanger (TSI), 96 time slots are assigned to the RISLU. The remaining time slots in the TSI are assigned to other units.

In order to establish a call, a time slot is chosen in the TSI and time slots of the same number must be available on the DFI and in the LGC. The stuffing patterns insure that there are an equal amount of each time slot number available in both the DFIs and the TSI. If the stuffing patterns were incorrectly defined, there would still be an equal amount of each time slot in the DFI and TSI, but there would be some time-slot numbers totally unavailable to the RISLU. For example, if all the DFIs were assigned stuffing pattern a, there would be no TSI time slot numbers 0, 4, 8, 16, 20, 24, and 28. This would reduce the number of paths to each line group by eight, thus reducing the amount of traffic that the LGC can carry. It is important that the stuffing patterns be assigned evenly across the DFI-Hs. If DFIs from a DLTU are assigned on the same DI, it is important that the stuffing patterns be assigned evenly across both the DFI-Hs and DFIs as one community. Failure to spread the patterns evenly can affect the performance of other units assigned to that DI. If only DFIs are assigned to a DI, failure to evenly spread stuffing patterns can cause initialization problems.

15.3.1.7.2 Host Switching Module Resources

To support a RISLU the host SM must have the loaded software configurations. This is required even if no

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ISDN services are required, for example, Z-card only. If ISDN services are required, the SM must be equipped with a packet switch unit (PSU) and the module controller and TSI unit 2 (MCTU2). All connections to the PSU require TSI time slots in addition to those required for the DLTU-R.

15.3.1.7.3 Service Circuits

A RISLU may be equipped with three types of service circuits:

(1) Two ring generator (RG) packs are required if Z-cards are equipped.

(2) Up to four metallic access network (MAN) packs can be equipped per RISLU. The four packs represent two service groups of two packs each. MAN packs provide access for ringing, metallic test and software-controlled, line-card sparing.

(3) Up to six high level service circuits (HLSC) may be equipped per RISLU. The HLSCs perform short jobs, for example, power cross tests and ringing job that overflow from the RGs.

15.3.2 ENGINEERING CONSIDERATIONS

In order to engineer a RISLU it is necessary to determine the number of time slots required for each of the following functions:

(1) D-channel transport

(2) B-channel X.25 packet switching

(3) Circuit-switched traffic.

A time slot is a 64 kB-channel. Unlike the ISLU, which has direct interfaces to the PSU, all the RISLUs traffic (both packet-switched and circuit-switched) is offered to the TSI. Time slots carrying packet traffic are nailed up across the TSI, while circuit-switched traffic is load shared (served at 90 percent occupancy or 32.4 ccs high day per time slot). Once the total number of time slots is known, it is possible to calculate the number of T1 spans required, and the number of LGCs required.

15.3.2.1 RISLU Time Slot Calculations

The BRIs D-channel is a 16 kB-channel. Four D-channels can be multiplexed by the RISLU onto a single time slot; however, RISLUs remoted via nonclear T1 spans do not have full use of the 64 kB DS0 channel. For nonclear T1 spans the RISLU multiplexes 3 D-channels per time slot. Since each BRI has one D-channel, the number of time slots required for D-channel transport via clear channel facilities can be calculated by dividing the total number of BRIs by 4. Similarly, the number of time slots required for D-channel transport via non clear facilities can be calculated by dividing the total number of BRIs by 3.

The BRIs B-channel is a 64 kB-channel. The B-channels with X.25 packet switching require a whole time slot. The B-channels used for circuit-switched voice and/or circuit-switched data are load shared (CCS sensitive). The Z-cards, when active, require a whole time slot, and are load shared. The number of time slots required for BRI circuit switching can be calculated by dividing the BRI CCS by 32.4 CCS per time slot (90 percent occupancy). Similarly, the number of time slots required for Z-card circuit switching can be calculated by dividing the Z-card CCS by 32.4 CCS per time slot.

The total time slots required per RISLU is the sum of the BRI requirement and the Z-card requirement.

15.3.2.2 Line Interface Data Bus

The LIDBs in a RISLU are operated in an ACTIVE/STANDBY configuration, which provides 32 time slots on a fully duplicated bus. Two of the 32 time slots are used for control and signaling, leaving 30 time slots

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for circuit-switched traffic and packet-switched nail-ups. Of the 30 remaining time slots, eight are engineered for D-channel nail-ups when the RISLU is equipped with clear channel facilities. The remaining time slots can carry up to 360 CCS of circuit-switched traffic. If the RISLU is equipped with nonclear facilities, eleven LIDB time slots are engineered for D-channel nail-ups; the remaining time slots can carry up to 252 CCS of circuit-switched traffic. The B-channels with X.25 packet switching reduce the circuit-switched traffic capacity of the LIDB by 36 CCS per channel.

15.3.2.3 Primary Rate Carrier Calculations

There are two modes in which the T1 spans used to remote a RISLU are operated. Mode 1 has 22 DS0 channels for traffic and 2 DS0 channels reserved for control and signaling. For normal operation two mode 1 T1 spans are required per RISLU. The RISLU will function in simplex state with one mode 1 T1 span. Mode 2 has 23 DS0 channels for traffic and 1 DS0 channel for signaling of the DFI-R in the RISLU cabinet. Up to 10 mode 2 T1 spans can be equipped on a RISLU.

A minimum of 10 percent spare time slots per RISLU is provided to reduce the potential for time slot mismatch between the RISLUs LIDB and PIDB. Since the CD does not have a TSI, mismatch occurs when a LIDB time slot can not be matched to a same numbered PIDB time slot. In any case, the customer may wish to provide a minimum of 23 extra time slots to provide capacity to recover failed T1 spans.

15.3.2.4 Line Group Controller Calculations

Each LGC in a RISLU is equipped with up to 32 cards, (T, U, or Z). A RISLU may have up to 512 cards, but is limited to 316 BRI cards due to a 190 nail-up restriction on the TSI in the host SM.

Each LGC in a RISLU has 30 traffic carrying time slots. The number of LGCs per RISLU can be limited by the number of cards or by the number of time slots required. The number of LGCs required for BRIs due to time slots can be calculated by dividing the total number of BRI time slots by 30. The number of LGCs required for BRIs due to card constraints can be calculated by dividing the total number of BRIs by 32.

Similarly, the number of LGCs required for Z-cards due to time slots can be calculated by dividing the total number of Z time slots by 30. The number of LGCs required for Z-cards due to card constraints can be calculated by dividing the total number of Z-cards by 32. The larger of the two requirements should be provided. The total number of LGCs (maximum of 16) required is the sum of the requirement and the Z-card requirement.

15.3.2.5 Service Circuit Calculations

If Z-cards are present in the RISLU, two RGs must be provided. Four MAN packs are provided if U-cards or Z-cards are equipped. In addition to metallic access, the MAN packs can provide access for the software-controlled sparing capability. Two MAN packs (one duplicated) will provide one spare per RISLU, and four MAN packs (two duplicated) will provide two spares per RISLU. Spares do not count toward the 316 BRI limit. When sparing U-cards, a maximum of two spare U cards are allowed per unit.

Up to six HLSCs (High Level Service Circuits) can be equipped in a RISLU with Z-cards, with a minimum of 2 HLSCs being provided in a RISLU with U-cards. HLSCs are not required for RISLUs equipped with T cards only. Table 15.3-1 provides the engineering recommendations for HLSCs to support Z-card traffic.

Table 15.3-1 HLSC Engineering Requirements

Z CCS	HLSC [a]
2073.60	2
3110.40	3
4147.20	4
6220.80	5
12441.60	6

Notes:

a. If U-card, a minimum of two HLSC are required.

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15.3.2.6 Packet Switch Unit Calculations

The minimum number of PSU shelves required for a RISLU is determined by the number of time slots nailed up to the TSI. Each PSU shelf can have a maximum of 32 time slots. Also, the number of PSU shelves could be limited by the number of PH (Protocol Handlers). A maximum of 16 PHs can be equipped per shelf. The number of PHs required is dependent upon the PPS (Packet Per Second) per D-channel and the PPS per B-channel. A 64 kB-channel can carry up to 32 PPS; therefore, each D-channel in the time slot can have an average of 8 PPS. To calculate the number of time slots per PH for a clear channel application, the average PPS per D-channel is divided into 8. Similarly, nonclear channel applications share the PH capacity among three D-channels, resulting in an average of 10.7 PPS per D-channel per time slot. To calculate the TSs (time slots) per PH for nonclear applications, the average PPS per D-channel is divided into 10.7. The minimum number of PHs required to support the D-channel is the number of D-channel time slots divided by the TS per PH. It is necessary to allocate the time slots to PSU shelves being careful not to exceed the 32 time slot limit.

Since the B-channels use a whole time slot, they do not arrive in "groups" of one. The minimum number of PHs required for B-channels can be calculated by multiplying the number of B-channel time slots by the average PPS per B-channel (total B-channel PPS) and dividing by the capacity of the PH. Again, the B-channels (1 time slot each) must be allocated to the PSU shelves to determine the actual number of PHs required. Remember that the number of B-channels and the number of D-channel time slots added together can not exceed 32 time slots per shelf.

The number of ISM (Inter-Switching Module) time slots required and the number of ISM PHs are each dependent upon the total PPS in the network and the PPS in each SM.

The PH provides the capability to define 384 LAPD (Lind Access Procedures D-channel) logical links. One logical link is required for a subscriber to circuit-switched voice and/or circuit-switched data on a BRI. An additional LAPD logical link is required for subscribers to D channel X.25 packet switching. For example, a BRI with two users each with circuit-switched voice and circuit-switched data and one of the users having X.25 D-channel packet switching, will require three LAPD logical links. Since 5E5 and later software releases allow up to eight subscribers per D-channel, each equipped with both circuit switching and packet switching, and since 5E5 and later software releases allow up to 128 D-channels per PH, there could potentially be a demand for 2048 logical links. If the 384 limit is exceeded, the PHs will be equipped with less than 128 channels and more PHs will be provided. Since the logical link is a Q.931 parameter, B-channels are not affected by this limit.

15.3.2.7 Host Switching Module Calculations

An SM can host up to 20 DFI-Rs, 4 DLTU-Rs and 8 RISLUs. An SM is allowed a maximum of 316 BRIs from RISLUs (this does not include ISLU lines) due to the 190 nail-up restriction. In addition, a SM can be DI port limited or time slot set limited in its engineering.

The SM hosting the RISLU must be equipped with the fully loaded software configuration, and be equipped with the MCTU2.

15.3.3 ASSIGNMENT GUIDELINES

15.3.3.1 Universal RISLU

The following assignment rules apply to Universal RISLU:

(1) Up to eight RISLUs can be supported on a SM.

(2) A RISLU can be hosted on an SM, an optically remote module (ORM), or a remote switching module (RSM).

(3) A RISLU must be equipped with two common control (CC) circuits.

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(4) A RISLU must be equipped with two CD circuits.

(5) A RISLU must be equipped with between 0 and 16 LGCs (0 occurs during growth).

(6) A RISLU can be equipped with between 2 and 12 PRC facilities. Two of these must be supported on DFI-H1/R1 pairs. The remaining facilities will be supported on DFI-H2/R2 pairs.

(7) A RISLU must be equipped with two RCLK packs.

(8) RISLU applications use an active/standby CD configuration.

(9) A RISLU must be hosted on one and only one DLTU-RH. That is, all host DFIs connected to one RISLU must appear on the same DLTU-RH.

(10) Up to two RISLUs can be hosted on one DLTU-RH, provided that the total number of facilities needed to support those two RISLUs does not exceed 16.

(11) It is not possible to move a RISLU from one DLTU-RH to another DLTU-RH without temporarily removing that RISLU from service.

(12) The assignment rules for the PICBs that are extended through the DFI-H1s to the remoted ISLU CC must follow the same assignment rules established for ISLU CC PICBs (CC 0 controlled by an even PICB, CC 1 controlled by CC 0 PICB +1).

(13) PIDBs connected to a RISLU should be connected to the same data interface (DI) boards if possible. If the PIDBs must be split across DI boards, they should be split evenly.

(14) The stuffing code patterns should be assigned to DFIs such that a uniform spread of patterns appears across the DFIs connected to a DI. The stuffing code patterns must also be spread uniformly across the DFIs assigned to a particular RISLU.

(15) The DFI mode assigned to each DFI on a RISLU must be identical.

(16) Each RISLU at the remote site must be supported from one and only one DLTU-RR.

(17) Only one RISLU can be supported per DLTU-RR.

(18) The DFI-R1 that provides control CC 0 must be equipped in DFI position 1 in the DLTU-RR. The two PIDBs from this DFI-R1 must connect to PIDB connection 0, PIDB side 0 on both CD service groups.

(19) The DFI-R1 that provides control CC 1 must be equipped in DFI position 2 in the DLTU-RR. The two PIDBs from this DFI-R1 must connect to PIDB connection 1, PIDB side 0 on both CD service groups. This DFI-R1 will also provide the extra set of timing signals to PIDB connection 0, PIDB side 1 on both CD service groups.

(20) Up to ten DFI-R2s can be equipped per RISLU. They can be equipped in any of the remaining DFI positions in the DLTU-RR. The two PIDBs from DFI-R2 must be connected to the same PIDB connection number on the two CD service groups. They must both be connected to PIDB side 0.

15.3.3.2 Enhanced RISLU

The ERISLU supports a mix of ACD and ISDN call types. The estimated number of calls per hour on the ERISLU varies depending upon the percentage of ACD calls. The throughput of the ERISLU remains the same as that of the Universal RISLU. The response time and blocking rate of the ERISLU due to switch resources remains the same as that of the Universal RISLU. The reliability and maintainability rate of the RISLU is not changed.

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15.3.4 PHYSICAL DESIGN

The RISLU is a 1 cabinet remote that is used for universal applications, OSPS applications, and international applications. In the universal application the link adapter unit (LAU) is not supported. An alarm status unit (ASU) may be equipped to provide visual alarm and status information to the craftsperson.

15.3.4.1 Remoting Distance

A RISLU may be remoted up to 175 miles from the host office. When a RISLU is hosted on an RSM, the total distance of the host to the RSM plus the distance from the RSM to the RISLU must not exceed 175 miles.

15.3.4.2 Features

The RISLU provides both analog and ISDN services with the same feature set as provided on the ISLU. However, the RISLU does not support On Demand B-channel Packet Switching. This feature requires that the serving unit be equipped with DPIDBs, but a RISLU does not support DPIDBs. For further information on features, refer to 235-190-101, *Business and Residence Modular Features*, or 235-190-105, *ISDN Feature Description*.

15.3.5 ADMINISTRATION

15.3.5.1 Universal RISLU Administration

The administration for the RISLU is different from the administration of the ISLU. The difference arises from the fact that the RISLU does not have DPIDBs, and requires time slots on the PSU shelfs PIDB. The administration requirements for RISLU are as follows:

(1) A RISLU may have a maximum of 512 cards of which, no more than 316 may be T- or U-cards.

(2) Each LGC equipped on a RISLU with clear channel facilities may have BRIs assigned to a maximum of eight PHs or BRI/DSL groups. This restriction arises from the LIDB time slot engineering that assumes 32 BRIs require no more that eight time slots.

(3) Each LGC equipped on a RISLU with nonclear channel facilities may have BRIs assigned to a maximum of 11 BRI/DSL groups. Again the engineering assumes that 32 BRIs require no more than 11 time slots.

(4) The LGCs with both Z-cards and BRIs may be restricted to fewer than eight BRI/DSL groups, if clear channel facilities and less than 11 PHs, if nonclear channel facilities.

(5) A PSU shelf can have a maximum of 128 RISLU BRIs assigned.

(6) Each RISLU permanent packet B-channel (PPB), also called X.25 nailed-up B-channels) channel assigned to a PSU shelf reduces the maximum number of RISLU BRIs per PSU shelf by four, if clear channel facilities, and by three, if nonclear channel facilities.

(7) Each ISM link assigned to a PSU shelf reduces the maximum number of RISLU BRIs per PSU shelf by four, if clear channel facilities, and by three if nonclear channel facilities.

(8) Each packet trunk (X.75, IP, 1PSS) reduces the maximum number of RISLU BRIs per PSU shelf by four, if clear channel facilities, and by three if nonclear channel facilities.

(9) For each BRI/DSL group having at least one assignment in a LGC, there should be multiples of three or four BRI/DSL assignments (depending upon whether the T1 is clear or nonclear) from that LGC in the same BRI/DSL group. When remote clock assigns the quarter time slots for the BRI/DSL

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it only chooses a quarter time slot from a used piggy-back time slot having the same BRI/DSL group and LGC association.

To maximize the use of the protocol handler and to populate the quarter time slots efficiently, lines should be assigned in groups of four when the T1-carrier is clear and in groups of 3 when the T1-carrier is nonclear.

The purpose of this section is to highlight the information needed to administer a RISLU.

15.3.5.1.1 Forecast

The first step to administration of the switch is to determine the amount of working lines in the office and the forecasted growth. Once the total amount of lines for the office has been determined, the next step is to break the list into the amount of lines by type of service, for example, voice, circuit-switched data, packet. This information will be needed to establish a loading plan.

NOTE: Lucent Technologies recommends designating protocol handlers (PH)s for ISDN assignments for each SM component [ISLU, RISLU, IDCU, and PH type; B-Channel (PPB), D-Channel (DPPS), and On-Demand B-Channel (ODB)]. This simplifies determining the total DPPS for PPB, D-Channel, ODB, and virtual calls. This data is required to traffic engineer and load balance the PHs.

Once segregation of PHs is completed by SM component and PH type, the switch administrator can provide total usage on the PHs by using TRFC30 Section 68. The OS used to make PH assignments must make assignments accordingly.

15.3.5.1.2 Equipment Configuration

The next step is to determine the equipment that was engineered for your office. This should be done with your traffic engineer, since the RISLU needs to be assigned as it was engineered, just like the ISLU.

For the host SM the equipment that is required:

- PSU
- DLTU-R
- ISDN Software - Loaded in SM
- MCTU2
- PH
- ISLU - optional.

For the RISLU the equipment that is required:

- LGC
- Cards - U, T, or Z
- 2 RG Packs (Required for Z-cards)
- 4 MAN Packs (Required for U- or Z-cards)
- Up to 6 HLSCs / RISLU

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- Time Slots
- DLTU -R.

15.3.5.1.3 Determining Office Capacity

Once the forecasted growth and the equipment configuration is known, the next step is to determine the office capacity.

(1) CCS Capacity of the RISLU - Obtain from your traffic engineer. The CCS capacity is determined for a RISLU by how many X.25 B-Channel Packet lines are engineered, how many ISMs, how many ISPTs, and whether the T1-carrier is clear channel (360 CCS/LGC) or nonclear channel (252 CCS/LGC).

(2) DPPS Capacity of the PH

(3) Capacity in Terminations

A RISLU can be equipped with a maximum of 512 Z-cards.

A RISLU can be equipped with a maximum of 316 U- or T-cards.

Or a RISLU can have a mixed configuration of BRI/DSLs and analog lines:

316 (U- or T-Cards) + 196 (Z Cards) = 512 Cards Maximum

(4) Primary Rate Carrier (T1 Carrier) - Determine the amount of links, and whether they are clear channel (B8ZS Format) or nonclear channel (ZCS Format).

(5) Protocol Handlers - Determine the quantity of PHs by type.

- Quantity of X.25 B-channels
- Quantity of X.25 D-channels
- Maximum assignments on BPH/DPH.

(6) Time Slots - Determine the amount of time slots available to use for line assignments:

Maximum 32 time slots per PSU shelf (TSIU to PSU shelf)

The actual number of time slots equipped in engineering.

The maximum CCS/time slot is 32.4 CCS (90 percent occupancy).

Each PIDB engineered uses 1/2 time slot set.
For example:

1 PIDB pair/shelf (duplicated)

32 TS/PIDB

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1 TS can handle a 64-kB channel

or 4 - 16 kB D-channels (Clear)

or 3 - 16 kB D-channels (Nonclear).

So Capacity would be:

32 time slots/PIDB x 4 (16 kB D-channels) = 128 BRIs per PSU shelf.

or

32 time slots/PIDB x 3 (16 kB D-channels) = 96 BRIs per PSU shelf.

(7) Logical Links - The D PH have a capacity of 384 logical links. One logical link is used for signaling and 1 Logical Link is used for X.25 Packet on the D-channel. (Reminder, this does not affect B-channel.)

(8) PPB lines, ISM, and ISPT reduce the capacity for line assignments in the RISLU by:

CLEAR T1 Carrier - Reduces capacity by 4 lines for each PPB, ISM, or ISPT assigned.

NONCLEAR T1 Carrier - Reduces capacity by 3 lines for each PPB, ISM, or ISPT assigned.

Based on the previous statements it is VERY important to find out the quantity for your office!

(9) Loading Plan - Step up a loading plan after you know the forecasted growth, the types of lines - analog or BRI/DSL, the equipment configuration of the RISLU and host SM, the capacity of your RISLU.

To establish your loading plan:

- First, review equipment configuration, for the RISLU look at how many LGCs and Cards you are equipped with.
- Second, review the host SMs PSU for the shelves that are equipped and where the PHs are located that will be used for assignments.
- Allocate PHs for RISLU (PSU is shared by ISLU in the same SM) by quantity and type.
- Determine if your T1 carrier is clear or nonclear channel.
- Determine quantity of PPB, ISM, and ISPT PH types /PSU shelf.
- Once you have determined all of the preceding, start assigning lines:

  Assign heavy usage lines first and spread them over all LGCs and PHs; the load should be spread evenly over all units provided.

- Assignments Constraints

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- Do not mix host and RISLU assignments on the same PHs.
- Do not mix BPH and DPH assignments.
- If clear channel facilities on T1 carrier - Each LGC may assign BRI/DSLs to a maximum of eight (8) PHs.
- If nonclear channel facilities on T1 carrier - Each LGC may assign BRI/DSLs to a maximum of 11 PHs.
- RISLU does not support on-demand B-channel packet switching (ODB).

15.3.5.2 ERISLU Administration

New TRFC30 measurements are not required. Existing TRFC30 measurements are sufficient to evaluate the ERISLU operation.

The following summarizes the load sharing philosophy of the ERISLU:

- The ERISLU uses the load sharing strategy of the Universal RISLU.
- The ACD/OSPS RISLUs formerly using the hot spare option for DFI-Hs use the load sharing strategy.

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Figure 15.3-1 Integrated Services Line Unit

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Figure 15.3-2 RISLU Architecture

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15.4 INTEGRATED DIGITAL CARRIER UNIT

15.4.1 DESCRIPTION

Integrated Digital Carrier Unit (IDCU) supports integrated digital loop carrier systems using Telcordia TR-008 and TR-303 requirements. The TR-303 requirement uses one DS0 time slot, embedded operations channel (EOC), for OA&M. Another DS0 time slot, time slot management channel (TMC), is used for call processing purposes. Support of OA&M and call processing functions by designated DS0 TSs facilitates 64 kbps clear channel for Integrated Services Digital Network (ISDN) data applications. In addition to ISDN support, IDCU supports nail-up and hairpin applications for non-switched and non-locally-switched services. Hairpin and nail-up can be defined as follows:

hairpin A connection in which a time slot is assigned a semi-permanent path between two DS0 ports on the same IDCU. The hairpinned connection does not use SM or CM time slots. Non-switched (single and multi-channel), non-locally-switched lines and ISDN tri-slot Basic rate Interfaces (BRIs) may be hairpinned.

nail-up A connection in which a time slot is assigned a semi-permanent path through the SM [or the SM and the communication module (CM)], between a DS0 port on IDCU and a DS0 port on another SM peripheral. Non-switched (single channel) and non-locally-switched lines may be nailed up.

The IDCU supports the following remote terminals (RTs):

- *SLC*® 96 carrier system remote terminals
  - Mode I
  - Mode II.
- *SLC*® Series 5 carrier system remote terminals
  - Feature package 303G (FP303G)
    - (a) TR008 Mode I
    - (b) TR008 Mode II
    - (c) TR303 interface (with concentrated ISDN).
  - Feature Package B (FPB)
  - Enhanced Feature Package B (FPB+) Mode I
  - Enhanced Feature Package B (FPB+) Mode II.
- *SLC*® 2000 RT
  - TR008 mode
  - TR303 mode.
- TR008 compatible RTs

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- TR303 compatible RTs that are equivalent to *SLC*® Series 5 FP303G RT.

The IDCU also supports the following systems with non-switched and non-locally switched services (no switched services are provided for these systems in this feature):

- D4 channel banks
- D5 channel banks
- DACS I
- DACS II
- DACS IV.

Although hybrid signaling (TMC plus ABCD bits) is used in the TR303 mode, CSC is not supported. The IDCU also supports *SLC*® 2000 remote digital terminal (RDT) operating in TR008 or TR303 mode.

The connection to digital loop carrier (DLC) environment is through a DS1 digital system cross-connect interface (DSX-1) in the central office (CO).

The following is the summary of the features provided by the IDCU:

- Interfaces DS1s to peripheral interface data buses (PIDBs) and directly connected peripheral interface data buses (DPIDBs)
  - Switched DS0s and B-channels to PIDBs
  - Time-slot management channel (TMC), EOC, D-channels, and packet B-channels to DPIDBs.
- Supports all switched services supported on digital carrier line unit (DCLU)
- Supports all end-user services provided by line unit (LU) and *ANSI*® U-digital subscriber line (DSL) on integrated service line unit (ISLU)
- Supports concentrated ISDN on TR303 RTs (Four D-channels per DS0)
- Supports TR008 applications using the standard SM
- Supports fiber-to-the-home
- Supports IDCU hair-pinning and SM nail-up of special services
- Provides DS1 facility monitoring and maintenance
- Provides blocked origination call counting
- Provides protection switching of DS1s and the TMC and EOC links
- Transports U-DSL performance monitoring information
- Supports Mode II SPOTS on TR008 RTs.

Figure 15.4-1 is a block diagram of the IDCU. Each block is a pack, and all packs are duplicated except the electrical line interfaces (ELIs).

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The ELI receives the DS1 signals. Each ELI may terminate 20 DS1s. A fully equipped IDCU has two ELI packs, but a partially configured IDCU has one. The ELI splits the signals to the active and standby loop interfaces (LSI). The ELIs also terminate the PIDB clock and synchronization signals for PIDBs 1 through 15. ELI A terminates PIDBs 1 through 8 and ELI B terminates PIDBs 9 through 15; thus, 2 ELIs are required when more than 4 TSSs are provided per IDCU.

The LSI receives the DS1 signals. Four LSIs are provided in fully equipped IDCUs: two active and two standby. The LSI converts the DS1 to PIDB-like format on the internal bus to the PIDB transmission interface (PTI). The PIDB is the connection from peripheral units to the time slot interchange (TSI) in the *5ESS*® switch. There are 32 time slots per PIDB.

The PTI contains a TSI function, thus enabling the DS0 time slot to be connected to any PIDB/DPIDB time slot. A maximum of 15 PIDBs is permitted (16 in the case of SM-2000). The sum of PIDBs plus two times the DPIDBs must not exceed 30. The PTI also supports a maximum of 11 DPIDBs.

15.4.2 ENGINEERING CONSIDERATIONS

15.4.2.1 General

t is recommended that the IDCU be engineered for Average Busy Season Busy Hour (ABSBH) and High Day (HD), whichever is more limiting. The following service provider forecasts are needed when planning and engineering for IDCU:

- Total lines installed by the end of the engineering interval
- Line traffic characteristics, for example, CCS/MS (one hundred call seconds per main station)
- Quantities of lines by service class, for example, ISDN, special services, etc.
- The number and configurations of remote terminals (RT).

Engineering algorithms and procedures are used for determining the number of IDCUs required and their affect on quantities of other switch resources, for example, SMs and packet switching units (PSUs). IDCU quantities are a function of :

- Subscriber traffic usage and attempts for both circuit-switched and packet-switched calls
- Blocked attempts in IDCU and concentrated RDTs
- Number of subscriber lines, including U-DSLs
- Number of semi-permanent cross connects for hair-pinned and nailed-up circuits
- Number of DS1s
- Number of RDTs with each type of IDLC interface.

The algorithms and procedures allow a service provider to engineer an IDCU to provide subscriber service consistent with existing grade of service criteria (for example, dial tone delay and matching loss) for ISDN and non-ISDN lines.

The number of PIDBs required is determined by the amounts of circuit-switched traffic. The number of DPIDBs is a function of the quantities of U-DSLs (D-channels), provisioned B-channels, on-demand B-channels, and TR-303 RDTs (EOCs and TMCs).

Signaling messages on the EOC and TMC data links of each TR-303 RDT must be added in calculating the quantities of PHs and PSUs for each SM. Only one PSU is allowed per SM.

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The number of RDTs that can be equipped in an IDCU is a function of the total quantity of DS1s used and the quantity of each type of IDLC interface employed. An IDCU can be arranged for 20 or 40 DS1s. This quantity minus the DS1s used for PUB 43801 applications is the number of RDTs that can be served. The *5ESS*® switch software limits the maximum number of RDTs per IDCU to 31.

When zero code suppression is specified for a TR-303 RDT, 10 DS1 time slots are unavailable for calls and semi-permanent cross connections. This reduces the traffic capacity of these facilities and may restrict the number of the lines that can be assigned to the RDT.

The conversion of a *SLC*® RT from one mode to another may have engineering implications. Precautions must be taken when converting from nonconcentrated to concentrated modes so that the traffic capacity of the remaining DS1s will provide an acceptable grade of service for the offered load.

There are no explicit limits placed on the number of nailed-up and hair-pinned connections that can be assigned to an IDCU. However, switch software resource limitations prevent nailing up or hair-pinning all of an IDCU's DS1 time slots.

15.4.2.2 IDCU on SM-2000

The IDCU on the SM-2000 feature provides applications for IDLC systems for analog, ISDN and special services. The IDCU on the SM-2000 feature is a port to the SM-2000 of the complete IDCU functionality which includes TR-303, both small and large lines, TR-008 and PUB43801 interfaces. A maximum of 37 IDCUs can be present on an SM-2000, with a software range of 42 units.

The porting of the IDCU functionality to the SM-2000 includes all those platforms that are applicable to the *5ESS*® Switch SM, HSM-2000, EXSM-2000, and CDX platform. In order to provide ISDN services on the IDCU on SM-2000 feature is dependent on the PSU2 being available for the same switch. The PSU2 will also provide service to the *5ESS*® Switch SM. The Data Fanout (DF) interface on the PSU2 will support the IDLC on SM-2000. The IDCU functionalities that are implemented by this feature on the SM-2000 will be transparent with the IDCU functionalities on the *5ESS*® Switch SMs.

15.4.2.3 IDCU RT CALCULATIONS-Ups

The following formulas govern the relationship between CCS, number of RT lines, concentration of RT lines, and packet information (TR303) only. These formulas are useful for quickly determining the number of time slots sets used and line concentration ratio for a given CCS per NAL at 100 percent fill of the RT.

15.4.2.3.1 IDCU for TR303 CCS per Line

Information that the customer must know to use these formulas:

(1) Percent Blocking 0-20% (TCBH=1.5% EVE=4% HD=7%)

(2) IDCU ACTIVE TSS 1-8 (Each active PIDB is equal to .5 TSS and a IDCU can have 2-16 active PIDBs)

(3) Total Number of lines in a IDCU 1-15,360

(4) Number of ISDN users in a IDCU 0-8190

(5) Number of Packet Switch Data (PSD) Users 0-8190 (Needed only if the IDCU is supporting multi-point)

(6) Number of (Permanent Packet B) PPB Users

(7) Number of TR303 RTs in IDCU 0-20

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(8) PPD PPS / LINE .02-8

(9) PPB PPS / LINE 8-32

(10) ODB PPS / LINE 8-12 PPS

(11) ODB CCS / LINE 1-21 CCS

Line Concentration Ratio (LCR) =

Number of IDCU lines

_____

IDCU ACTIVE TSS □ 64

CCS/MS =

POISSON TABLE LOOKUP (P_BLOCKING, Number of circuits = TSS □ 64)

_____

NUMBER OF IDCU LINES

Number of PPD DPIDBs =

ROUNDUP (ROUNDUP (Number of IDCU ISDN LINES □ 4) +

(Number of TR303 RTs □ 4))

_____

32

Number of PPB DPIDBs =

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#PPB LINES ((PPD DPIDB □ 32)

(ROUNDUP (Number of IDCU ISDN LINES □ 4) +

(Number of TR303 RTs □ 4)))

_____

32

NOTE: If PPB DPIDBs is negative, then PPB DPIDBs = 0

because there is enough TSs in the PPD DPIDBS

to assign PPB TSs.

Number of PPD PHs =

MAX ((ROUNDUP (Number of IDCU LINES□4) + (Number of

TR303 RTs □ 4)] □ 32,

(Number of ISDN lines □ PPD PPS per LINE □ 200),

(Number of PSD users □ 128))

Number of PPB PHs =

MAX ((Number of PPB lines □ PPB PPS per LINE □ 200),

(Number of PPB lines □ 32))

Number of ODB PH3/PH4 =

MINIMUM of 32 or (200 PPS □ number of PPS per ODB) =

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"X" users per ODB

36 CCS □ 0.625 occupancy □ number of CCS per ODB = "Y" users

MINIMUM of (32, or "X"□"Y") = "Z" ODB user per PH3/4

Number of ODB users per IDCU □ "Z" = number of PH3/4 for ODB

Number of ODB DPIDBs =

(Number of ODB users per IDCU) □ (ODB CCS per user)

_____

(720 CCS per DPIDB)

15.4.2.3.2 IDCU for TR008 CCS per Line

Each RT assumes 96 lines. These table values apply both to Modes I and II and both modes have fully equipped DS1s. Based on these assumptions, Table ### is constructed using the following calculations:
96 □ 8 RT □ 2.24 (ABS) = 1,720 CCS

96 □ 8 RT □ 2.38 (EVE) = 1,827 CCS

96 □ 8 RT □ 2.46 (HD) = 1,889 CCS

Line concentration ration = 8 □ 96 □ 64 = 12

15.4.2.4 Capacities, Limitations, and Restrictions

An IDCU can be equipped with up to 40 DS1s. The RDTs with varying numbers of DS1s and using either the TR303 or TR008 interface can be mixed on the same IDCU. The RDT capacity of an IDCU is a function of the number of DS1s, the number of subscriber lines, and the traffic load generated by subscribers. There may be up to thirty one (31) RT TR303s per IDCU.

Within an SM, up to 4,096 POTS and ISDN lines can be served by one or more IDCUs. A maximum of 1,024 ISDN Subscribers can be assigned/IDCU.

The PIDBs for an IDCU are arranged in two service groups, an active group and a standby group. The number of PIDBs required is a function of an IDCU's circuit-switched traffic usage. The maximum engineered CCS capacities are determined using the Poisson model at 1.5% ABS, 4% EVE, and 7% HD not to exceed 90% occupancy on the PIDBs.

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Table 15.4-1 IDCU CCS Capacities

Active PIDBs	ABS (1.5%)	EVE (4%)	HD (7%)
1	755	821	867
2	1,724	1,825	1,894
3	2,736	2,864	2,950
4	3,769	3,920	4,022
5	4,817	4,988	5,103
6	5,874	6,064	6,190
7	6,940	7,146	7,258
8	8,011	8,233	8,294
9	9,087	9,324	9,331
10	10,167	10,368	10,368
11	11,251	11,405	11,405
12	12,338	12,442	12,442
13	13,427	13,478	13,478
14	14,515	14,515	14,515
15	15,552	15,552	15,552
16	16,589	16,589	16,589

An IDCU can be configured for up to 15 active PIDBs (SM) or 16 active PIDBs (SM-2000).

The ISDN is only available from RDTs using the TR303 interface with IDCU. If an IDCU serves ISDN lines, it must be installed in an ISDN SM(or a loaded SM). If an IDCU does not serve any TR-303 RDTs, it may be installed in a Standard SM. Up to 11 active/standby DPIDB pairs can be connected to the packet switch unit(PSU) to serve the packet-switched traffic for an IDCU. The messages carried on the EOC and TMC data links are also routed to the PSU. The use of DPIDBs reduces the maximum number of PIDBs available for circuit-switched traffic per IDCU. The number of available PIDBs is reduced by two(2) for each DPIDB deployed.

The IDCU does not support BRI/DSLs employing the T-interface. All DS1s from any one RT must be assigned to the same IDCU.

15.4.2.5 Remote Terminal Assignment Guidelines

The following procedures must be followed when assigning RTs to the IDCUs:

- Make a list of all the RTs and the engineered DS1s. The RTs that have four DS1s with a protection line should be assigned first followed by other RTs down to those with one DS1 and no protection.
- Assign the DS1s from one RT equally between both LSIs of a fully equipped IDCU to take advantage of modularity. For example, for an RT with four DS1s, assign two DS1s to LSI-A and the other two DS1s to LSI-B.
- Assign each RT to a different IDCU subtracting the engineered DS1s and protection lines from the totals allowed. Assign succeeding RTs to the SMs with the most RT/DS1 space remaining until all RTs are assigned.

15.4.2.6 Assignment Methodology

15.4.2.6.1 Objectives

Assignments made within the IDCU depend upon the cable and pair assignment, or the *SLC*® unit and pair. Lucent Technologies recommends making permanent assemblies in your line assignment system (currently used in DCLU line assignment). A permanent assembly is a connection of the cable and pair to the office equipment (OE).

Parameter	Resource
Termination and Type	Remote Terminal - *SLC*® Unit and Card (TR008)
Termination and Type	Remote Terminal Line Size (TR303) - 1-2048
Terminations/IDCU	4096 POTS and ISDN lines per SM/ 15,360 POTS ISDN lines per

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	SM-2000
Remote Terminals TR303/IDCU	20 Remote Terminals
IDCU CCS Capacity	Quantity of PIDBs
ISDN Capacity	Quantity of DPIDBs, PIDBs, PHs
PH Termination	PH3/PH4 - 128 Terminations
ISDN DPPS Capacity	PH3/PH4 - 200 DPPS

If more than one SM is engineered for TR303 with the ISDN capability, inter-SM protocol handlers are provided in DOPSMOD.

NOTE: Lucent Technologies is removing the recommendation of segregating assignments of PHs by SM component (ISLU, RISLU, IDCU, ISLU2, AIU, and TR-303 on DNU-S). ISDN customers use the same applications whether the lines terminate in an ISLU, ISLU2, IDCU, etc. The DPPS inputs to 5 DOPS should be obtained from TRFC30 Section 68. Traffic engineers may use the same DPPS entries for each SM component based on actual data or estimated PPS based on specific customer's needs.

In addition to removing the recommendation of segregating assignments of SM component, it is possible to mix Permanent Packet B-Channels with D-Channel Packet and Access Digital Service Lines. To accomplish the required DPPS entries for 5 DOPS, utilize the DPPS from TRFC30 Section 68 from the "Access PHs" as a guideline for forecasting future packet demand.

DOPSMOD requires inputs for engineering RT DPPS. As a result, all assignments on one RT may be assigned to one PH.

15.4.2.6.2 RT Equipment Configuration

The first step in making line assignments is to know the configuration of the engineered equipment. This section identifies the information required to understand how the office is configured for TR303 and PUB43801. Office configuration may be obtained from the DOPSMOD Equipment Report (TR008), DOPSMOD ISA Report (TR303), ODA (Office Data Assembler) Forms, Office Records, and/or Recent Change Views.

15.4.2.6.2.1 DOPSMOD Equipment Report

The DOPSMOD Equipment Report is part of the Traffic Equipment Order (TEO) and lists all the equipment provided for the *5ESS*® switch. The equipment report is generated for initial offices or growth jobs. Engineered equipment for the IDCU application may be found on this report. Lucent recommends verification of the equipment report with actual switch office records, ODA Records, or Recent Change Views. Discrepancies should be reported to the traffic engineer to be resolved and DOPSMOD updated, if necessary.

15.4.2.6.2.2 DOPSMOD ISA Report

The ISA report is created in DOPSMOD when Integrated Services Digital Network (ISDN) is engineered in the *5ESS*® switch. The ISA Report shows the equipment configuration of the ISDN hardware in the SM. In DOPSMOD, the ISA report may be accessed from three levels; ISDN, ISLU (Integrated Services Line Unit), or PSU (Packet Service Unit). The ISA report also provides the IDCU TR303 equipment configuration.

The ISA report is part of the Traffic Equipment Order (TEO). The traffic engineer has the responsibility to maintain the DOPSMOD data base for each *5ESS*® switch office, including ISDN/IDCU. It is imperative that DOPSMOD be updated to reflect any deviation from the configuration reflected on the ISA Report. Changes may be made to the original order of the ISDN/IDCU/PSU equipment layout if the traffic engineer has not specified a proposed equipment layout or if the Lucent Technologies regional engineer identifies potential equipment savings or problems. When there is a need for Lucent Technologies to modify the original request for equipment on the TEO, the service provider equipment engineer MUST be notified and MUST give Lucent Technologies permission to change the order. The switch administrator must report

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any discrepancies noted on the ISA report to the traffic engineer to resolve.

NOTE: In the current DOPSMOD, subsequent to Lucent engineering, the user may assign the correct number to the ISDNSM, PSU, or IDCU by using the external number command. The 235-060-110 *DOPS Users Guide Document* has detailed information on editing the ISDN SM number using the extnbr command.

15.4.2.6.2.3 Using the ISA Report

The ISA report is used by traffic engineers and switch administrators. The traffic engineer uses the ISA report to convey to Lucent and line and number personnel the assignment of ISDN resources.

The switch administrator uses the ISA report to determine the equipment layout of the ISDN equipment; including the ISLU, IDCU, LGC, BRI/DSL cards, PIDBs, DPIDBs, PSU, shelves, protocol handlers, and packet trunking. Although references are made to the ISLU and associated equipment, we will focus only on the IDCU portion of the ISA report.

The ISA report can be changed. It is important that the ISA report used is the MOST current version available. The DOPSMOD data base MUST be updated by the traffic engineer to reflect any changes. Administrators should contact their respective traffic engineer to verify the ISA report is the most current issue.

Since changes may be made to the original ISA report, once the ISDN equipment is in the *5ESS*® switch, the switch administrator and/or the traffic engineer should verify the equipment layout on the ISA report with the actual switch configuration. Request your Switching Control Center (SCC) or technicians to obtain the office records or recent change views (RC/V) to be used to verify the ISDN equipment layout. Detailed information for the Recent Change Verify Views, Office Data Assembler (ODA) Forms, and Office Records can be found in Sections 15.4.2.6.2.5 through 15.4.2.6.3 .

When there are any discrepancies between the switch and the ISA report, the traffic engineer MUST be notified so the differences can be resolved and the ISA report updated.

15.4.2.6.2.4 Sample TEO Version of IDCU DOPSMOD Reports

The following is an example of an rtlist (list of remote terminals), ISDN SM Assignments (ISA report), Equipment Report, and Capacity Report for TR008 and TR303, respectively. The first step in engineering an office for IDCU TR008 and/or TR303 is to determine the number of RTs, CCS/NAL and when TR303 is engineered, ISDN characteristics. Information for engineering an IDCU is found in the Engineering Procedures Document. Examples of the rtlist, ISDN SM Assignments (ISA report), Equipment Report, and Capacity Report will be used to answer questions typically asked by administration personnel.

The traffic engineer determines the number of RTs to engineer for IDCUs by the use of marketing forecasts or customer requests for service. In addition to the number of RTs, the traffic engineer accumulates additional data to input into DOPSMOD, such as projected CCS/NAL, number of hairpin and nailup, projected penetration of ISDN/RT, number of packet users by type (PPB, ODB, DPKT), Circuit Switch Voice and data users per ISDN line.

Refer to the 235-060-110, *DOPSMOD Switch Engineering Procedures (SEP)* for a complete list of all DOPSMOD symbols used to engineer the *5ESS*® switch.

Sample DOPSMOD Remote Terminal List for TR008 and TR303 Applications:

rtlist

(IDCU-1 SM #1) IDCU-2 NON-ISDN IDCU-3 NON-ISDN IDCU-4 NON-ISDN

TR3-49 TR3-53 TR8-1 TR8-25 TR8-2 TR8-26 TR8-3 TR8-27

TR3-50 TR3-54 TR8-7 TR8-31 TR8-8 TR8-32 TR8-9 TR8-33

TR3-51 TR3-55 TR8-13 TR8-37 TR8-14 TR8-38 TR8-15 TR8-39

TR3-52 TR3-56 TR8-19 TR8-43 TR8-20 TR8-44 TR8-21 TR8-45

IDCU-5 NON-ISDN IDCU-6 NON-ISDN IDCU-7 NON-ISDN

TR8-4 TR8-28 TR8-5 TR8-29 TR8-6 TR8-30

TR8-10 TR8-34 TR8-11 TR8-35 TR8-12 TR8-36

TR8-16 TR8-40 TR8-17 TR8-41 TR8-18 TR8-42

TR8-22 TR8-46 TR8-23 TR8-47 TR8-24 TR8-48

Sample DOPSMOD ISA report for TR008 and TR303 Applications:

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

.

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = ISDN

ORDNO = 12345 STATE = sto XGEN = 9.10

OFFICE TOTALS

ISLU IDCU

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CCSPTSM HD WEIGHTED AVG CCS / BRI/DSL CARD 2.02

BRITCRD BRI/DSL T LINE CARDS 0

U2B1QCD BRI/DSL 2B1Q U LINE CARDS 0

UAMICD BRI/DSL AMI U LINE CARDS 0

ZCRD Z LINE CARDS 0

TUZCRD TOTAL LINE CARDS / IDCU LINES 0 5152

TR303 NO. OF TR303 RTs IN IDCUs 8

TR008 NO. OF TR008 RTs IN IDCUs 48

NRT NO. OF PUB43801 DS1s IN IDCUs 14

DPPS WEIGHTED AVG PPS / D-CHANNEL 0.02

PPB NO. OF PERM. PKT B-CHANNELS 0 8

PPBPPS PERM. PKT B PEAK PPS PER PPB 0.00 20.00

ODB NO. OF ON-DEMAND B USERS 0 0

ODBCCS DPIDB OCCUPANCY CCS PER ODB 0.00 0.00

ODBPPS ON-DEMAND B PEAK PPS PER OD 0.00 0.00

PH2SPR NO. SPARE PH2 / PSU SHELF 1

PH3SPR NO. SPARE PH3 / PSU SHELF 1

XISTF ISTF OPTION (YES / NO) n

IDCU NO. OF IDCU UNITS 7

XSPLFCT UNIFORM INTER-SM CONN. FACTOR 1.20

BRIPLGC BRI/DSL CARDS / LINE GRP CNTRLR 0

MAXPIDB MAXIMUM PIDBS AT THIS CCS-ISLU 0

BRILGC NO. LGC REQD FOR BRI/DSL - ISLU 0

ISDNSM NUMBER OF ISDN SMS REQUIRED 1

DLTUSM NUMBER OF ISDN SMS WITH DLTU 0

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ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = ISDN

ORDNO = 12345 STATE = sto XGEN = 9.10

ISDN SM No. 1

		ISLU Qty	PH	IDCU Qty	PH
Summary					
CCSPTSM	HD WEIGHTED AVG CCS / BRI/DSL CARD	2.02			
BRITCRD	BRI/DSL T LINE CARDS	0			
U2B1QCD	BRI/DSL 2B1Q U LINE CARDS	0			
UAMICD	BRI/DSL AMI U LINE CARDS	0			
ZCRD	Z LINE CARDS	0			
TUZCRD	TOTAL LINE CARDS / IDCU LINES	0		736	(3)
TR303	NO. OF TR303 RTs IN IDCUs	8			
TR008	NO. OF TR008 RTs IN IDCUs	0			
NRT	NO. OF PUB43801 DS1s IN IDCUs	2			
PPB	NO. OF PERM. PKT B-CHANNELS	0		8	(3)
PPBPPS	PERM. PKT B PEAK PPS PER PPB	0.00			
DPPS	WEIGHTED AVG PPS / D-CHANNEL	0.02			
ODB	NO. OF ON-DEMAND B USERS	0		0	
ODBCCS	DPIDB OCCUPANCY CCS PER ODB	0.00			
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	0.00			

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PH2RAT PH2 PER DPIDB (1/4 ISLU BASIS) 0.00

PH3RAT PH3 PER DPIDB (1/4 ISLU BASIS) 0.00

ISMPH AVG INTER-SM PROTOCOL HANDLERS 0 EST.(ON PH3) 0 ASGN

PSUSHVS NO. PSU SHELVES IN THE ISDN SM 1

DSU2IF QTY OF ISTF PACKS ON DSU-2 0

IDCU NO. OF IDCU UNITS 1

RPATS RESERVED RPA/RPM T.S. PER SHF 0

INSMPPS EST. PPS FOR INTER-SM PKT TPT 0

SM PIDB and LG breakdown PIDBs LGs

IDCU# 1 6

SUM PIDBs 6

SUM LGs 0

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = ISDN

ORDNO = 12345 STATE = sto XGEN = 9.10

IDCU PROTOCOL HANDLER ASSIGNMENTS

IDCU# 1 -- X.25B -- --------- PSU ----------

PIDB DPIDB PPB ODB PH2 PH3 shelf port

6 A (0) 0 0 0.00 1.00 0 a

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```
B ( 1)   0     0     0.00   1.00    0   b
C ( 2)   0     0     0.00   1.00    0   c
D ( 3)   0     0     0.00   1.00    0   d
E ( 4)   0     0     0.00   0.00
F ( 5)   0     0     0.00   0.00
G ( 6)   0     0     0.00   0.00
H ( 7)   0     0     0.00   0.00
I ( 8)   0     0     0.00   0.00
J ( 9)   0     0     0.00   0.00
K (10)   0     0     0.00   0.00
```

```
IDCU# 1                  PROT ISDN  ANALOG      PIDB
RT#  TR   IDENTIFIER     DS1  LINE LINES LINES  USERS NUTS
49   303            4    0    20   72    20    0
50   303            4    0    20   72    20    0
51   303            4    0    20   72    20    0
52   303            4    0    20   72    20    0
53   303            4    0    20   72    20    0
54   303            4    0    20   72    20    0
55   303            4    0    20   72    20    0
56   303            4    0    20   72    20    0
NRT  PUB            2                   0
```

```
        PSU#   1    PROTOCOL HANDLER ASSIGNMENTS
    DPIDB port                  - ism -     - trk/cnl -  spare  total
sf  a(0)__b(1)__c(2)__d(3)__e(4)__f(5)   p2 p3 ts   p2 p3   p2 p3  p2 p3  sum
4  0.00   0.00  0.00  0.00  0.00  0.00   0   0  0   0  0    0   0  0   0    0
3  0.00   0.00  0.00  0.00  0.00  0.00   0   0  0   0  0    0   0  0   0    0
```

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```
2  0.00   0.00  0.00  0.00  0.00  0.00   0   0  0   0  0    0   0  0   0   0
1  0.00   0.00  0.00  0.00  0.00  0.00   0   0  0   0  0    0   0  0   0   0
0  1.00   1.00  1.00  1.00  0.00  0.00   0   0  0   0  0    0   1  0   5   5
```

```
              5ESS Switch Engineering System

                   ISDN SM ASSIGNMENTS


ISSUE:  16.00  VERSION:  2                    DATE: 21FEB94 @ 13:18 CST

--------------------------------------------------------------------------------

NPA   = 303          LD     = Base Load Division   LOCATION  = domestic

CLLI  = grfngama22c   TYPE    = host              CATEGORY  = ISDN

ORDNO = 12345        STATE   = sto               XGEN      = 9.10

--------------------------------------------------------------------------------


 Active PIDBs + DPIDBs for IDCU#  1 =  11

 Total IDCU to TSIU PIDB Ports         6

 Remaining TSIU Ports                 23


 ISLU PIDB TS            0    Reserved TS for NXDS0          0

 IDCU PIDB TS            96   Spare TS for any unit -->     414

 ISTF TS                 0    PSU TS demand                  0

 DLTU TS                 0    Available TS for PSU only      0

 Inter-SM TS             0    IDCU Nail-up TS for TSIU       0

 Packet Trunk TS for PSU  0    Used Nail-up TS for TSIU       0

 Recovered DLTU TS     (  0)   Avail Nail-up TS for TSIU     190
```

Sample DOPSMOD Equipment Report for TR303 Application:

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EQUIPMENT REPORT

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = idcu-1

ORDNO = 12345 STATE = sto XGEN = 9.10

DOPSMOD SYMBOL	DOPSMOD TITLE	PRESENT	ADDL	DEF	PROPOSED	E / O
CU303RT	TR303 RT(S) IN THIS IDCU	0	8		8	
PIDB	TSIU PIDB(S)/IDCU	0	6		6	
PPBX25D	PPB CHANNELS ON DPIDB-D	0	8		8	
DPAPH3	PH3(S) ASSOCIATED WITH DPIDB-A	0.00	1.00		1.00	
DPBPH3	PH3(S) ASSOCIATED WITH DPIDB-B	0.00	1.00		1.00	
DPCPH3	PH3(S) ASSOCIATED WITH DPIDB-C	0.00	1.00		1.00	
DPDPH3	PH3(S) ASSOCIATED WITH DPIDB-D	0.00	1.00		1.00	
IDCU	ONE IDCU EQP FOR 20 DS1(S)	0	1		1	
IDCUADL	ADD'L 20 DS1(S) FOR ONE IDCU	0	1		1	

Sample DOPS TR303 Capacity Report:

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CAPACITY REPORT

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NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = idcu-1

ORDNO = 12345 STATE = sto XGEN = 9.10

---

5 DOPSMOD

SYMBOL	5 DOPSMOD TITLE	QTY	DEMAND	CAPACITY	%UTL
IDCUHD	IDCU TCBH HD TO ABS RATIO	1.00			
IDCUBLK	PCT BLOCKING ON IDCU	1.50			
ABSCCS	WT AVG DS1 ABS NON-NU CCS/LINE	3.50			
HDCCS	WT AVG DS1 HD NON-NU CCS/LINE	3.50			
PTSLCR	IDCU CIRCUIT SWITCHED LCR	9.74			
CULINES	IDCU TR008 + TR303 LINES	736			
CURTDS1	IDCU RT DS1 MINUS PROT LINES	32			
CUTSHR	IDCU RT TIME SLOT INFO HEADER	***			
DS1TSD	TR008 + TR303 DS1 TIME SLOT DE	204			
CSTSD	TR008/TR303 CKT SW AND ODB TS	92			
PPDNUTS	TR303 PPD TIME SLOTS	40			
PPBNUTS	TR303 PPB TIME SLOTS	8			
TSINUTS	TR008+TR303 TSI NON-SW SPC TS	0			
HPINUTS	IDCU HAIRPIN TIME SLOTS	32			
MTCETS	TR003 EOC/TMC TIME SLOTS	32			
DS1TSC	TR008+TR303 DS1 TIME SLOT CAP	768			
DS1TSU	TR008+TR303 DS1 TIME SLOT UTL	27			

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CUPUDS1 IDCU NRT DS1(S) 2

CUPUTS NRT TSI NON-SWTCH SPECIAL TS 0

PITSDEM IDCU PIDB TIME SLOT DEMAND 92

PITSCAP IDCU PIDB TIME SLOT CAPACITY 96

PITSUTL IDCU PIDB TIME SLOT UTL 96

CUUSGHR IDCU USAGE INFO HEADER ***

CUCCSDE IDCU PIDB WT. AVG. CCS/LINE DE 3.50

CUCCSCA IDCU PIDB CCS/LINE CAPACITY 5

CUCCSUT IDCU PIDB CCS/LINE UTL 70

IDCUTD IDCU PIDB LINE DEMAND 736

IDCUTC IDCU PIDB LINE CAPACITY 768

IDCUTU IDCU LINE UTL 96

CUUSGTD IDCU PIDB USAGE DEM - LINES 736

CUUSGTC IDCU PIDB USAGE CAP - LINES 889

CUUSGCD IDCU PIDB USAGE DEMAND - CCS 2576

CUUSGCC IDCU PIDB USAGE CAP - CCS 3111

CUUSGU IDCU USAGE UTL 83

IDCUMLU IDCU MOST LIMIT - USG (ABS,HD) abs

IDCUML IDCU MOST LIMIT - (USG, LINES) lines

IDCUMLC IDCU ML CAPACITY IN LINES 768

CUDCHI IDCU D-CHAN PKT INFO HEADER ***

CUPKTLN IDCU ISDN LINES 160

CUDPPS IDCU WT. AVG. D-CH DATA PPS/LN 2.00

DCHDPD IDCU D-CHAN DPIDB(S) 3

DCHPDPB IDCU D-CHAN PER DPIDB RATIO 80.00

DPPSDEM IDCU D-CHAN DPPS DEMAND 320

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CAPACITY REPORT

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NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = idcu-1

ORDNO = 12345 STATE = sto XGEN = 9.10

---

5 DOPSMOD

SYMBOL	5 DOPSMOD TITLE	QTY	DEMAND	CAPACITY	%UTL
DPPSCAP	IDCU D-CHAN DPPS PH CAPACITY			480	
DPPSUT	IDCU D-CHAN DPPS PH UTIL.				67
CUPPBI	IDCU PPB PKT INFO HEADER		***		
IDCUPPB	IDCU PPB CHANNELS		8		
CUBPPS	IDCU WT. AVG. PPB DATA PPS/LN		20.00		
PPBDPD	IDCU PPB DPIDB(S)		1		
PPBPDPD	IDCU PPB PER DPIDB RATIO		8.00		
BPPSDEM	IDCU PPB DATA PPS DEMAND			160	
BPPSCAP	IDCU PPB DATA PPS PH CAPACITY			160	
BPPSUTL	IDCU PPB DATA PPS PH UTIL				100
CUODBI	IDCU ODB USER INFO HEADER		***		
IDCUODB	IDCU ODB USERS		0		
CCSPODB	IDCU WT AVG CCS/ODB USR -DPIDB		0.00		
PPSPODB	IDCU WT AVG DATA PPS/ODB USER		0.00		
ODBDPD	IDCU ODB DPIDB(S)		0		

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ODBDPDE	IDCU ODB CCS DPIDB DEMAND	0
ODBDPCA	IDCU ODB CCS DPIDB CAPACITY	0
ODBDPUT	IDCU ODB CCS DPIDB UTL	0
AVGUSPH	IDCU ODB AVG USERS/PH - DEMAND	0
ODBASPH	IDCU ODB USERS/PH - CAPACITY	0
AVGUSUT	IDCU ODB AVG USERS/PH - UTL	0

Sample Equipment Report for a TR008 Application:

5ESS Switch Engineering System

EQUIPMENT REPORT

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = idcu-2

ORDNO = 12345 STATE = sto XGEN = 9.10

---

5 DOPSMOD

SYMBOL	5 DOPSMOD TITLE	PRESENT	ADDL	DEF	PROPOSED
CU008RT	TR008 RT(S) IN THIS IDCU	0	8		8
PIDB	TSIU PIDB(S)/IDCU	0	6		6
IDCU	ONE IDCU EQP FOR 20 DS1(S)	0	1		1
IDCUADL	ADD'L 20 DS1(S) FOR ONE IDCU	0	1		1

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Sample Capacity Report for TR008 Application:

```
                5ESS Switch Engineering System

                     CAPACITY REPORT

ISSUE:  16.00  VERSION:  2                    DATE: 21FEB94 @ 13:18 CST

------------------------------------------------------------------------------

NPA   = 303          LD      = Base Load Division   LOCATION  = domestic

CLLI  = grfngama22c   TYPE    = host               CATEGORY  = idcu-2

ORDNO = 12345         STATE   = sto                XGEN      = 9.10

------------------------------------------------------------------------------

 DOPSMOD

SYMBOL     5 DOPSMOD TITLE                    QTY    DEMAND   CAPACITY  %UTL

------------------------------------------------------------------------------

IDCUHD     IDCU TCBH HD TO ABS RATIO           1.00

IDCUBLK    PCT BLOCKING ON IDCU                1.50

ABSCCS     WT AVG DS1 ABS NON-NU CCS/LINE      3.50

HDCCS WT AVG DS1 HD NON-NU CCS/LINE            3.50

PTSLCR     IDCU CIRCUIT SWITCHED LCR           8.00

CULINES    IDCU TR008 + TR303 LINES            736

CURTDS1    IDCU RT DS1 MINUS PROT LINES         32

CUTSHR     IDCU RT TIME SLOT INFO HEADER        ***

DS1TSD     TR008 + TR303 DS1 TIME SLOT DE       124

 CSTSD    TR008/TR303 CKT SW AND ODB TS          92

 PPDNUTS  TR303 PPD TIME SLOTS                   0

 PPBNUTS  TR303 PPB TIME SLOTS                   0

 TSINUTS  TR008+TR303 TSI NON-SW SPC TS          0

 HPINUTS  IDCU HAIRPIN TIME SLOTS                32

 MTCETS   TR003 EOC/TMC TIME SLOTS               0
```

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DS1TSC TR008+TR303 DS1 TIME SLOT CAP 768

DS1TSU TR008+TR303 DS1 TIME SLOT UTL 17

CUPUDS1 IDCU NRT DS1(S) 2

CUPUTS NRT TSI NON-SWTCH SPECIAL TS 0

PITSDEM IDCU PIDB TIME SLOT DEMAND 92

PITSCAP IDCU PIDB TIME SLOT CAPACITY 96

PITSUTL IDCU PIDB TIME SLOT UTL 96

CUUSGHR IDCU USAGE INFO HEADER ***

CUCCSDE IDCU PIDB WT. AVG. CCS/LINE DE 3.50

CUCCSCA IDCU PIDB CCS/LINE CAPACITY 5

CUCCSUT IDCU PIDB CCS/LINE UTL 70

IDCUTD IDCU PIDB LINE DEMAND 736

IDCUTC IDCU PIDB LINE CAPACITY 768

IDCUTU IDCU LINE UTL 96

CUUSGTD IDCU PIDB USAGE DEM - LINES 736

CUUSGTC IDCU PIDB USAGE CAP - LINES 889

CUUSGCD IDCU PIDB USAGE DEMAND - CCS 2576

CUUSGCC IDCU PIDB USAGE CAP - CCS 3111

CUUSGU IDCU USAGE UTL 83

IDCUMLU IDCU MOST LIMIT - USG (ABS,HD) abs

IDCUML IDCU MOST LIMIT - (USG, LINES) lines

IDCUMLC IDCU ML CAPACITY IN LINES 768

CUDCHI IDCU D-CHAN PKT INFO HEADER ***

CUPKTLN IDCU ISDN LINES 0

CUDPPS IDCU WT. AVG. D-CH DATA PPS/LN 0.00

DCHDPD IDCU D-CHAN DPIDB(S) 0

DCHPDPB IDCU D-CHAN PER DPIDB RATIO 0.00

DPPSDEM IDCU D-CHAN DPPS DEMAND 0

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CAPACITY REPORT

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NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = idcu-2

ORDNO = 12345 STATE = sto XGEN = 9.10

DOPSMOD

SYMBOL	5 DOPSMOD TITLE	QTY	DEMAND	CAPACITY	%UTL
DPPSCAP	IDCU D-CHAN DPPS PH CAPACITY			0	
DPPSUT	IDCU D-CHAN DPPS PH UTIL.			0	
CUPPBI	IDCU PPB PKT INFO HEADER	***			
IDCUPPB	IDCU PPB CHANNELS		0		
CUBPPS	IDCU WT. AVG. PPB DATA PPS/LN		0.00		
PPBDPD	IDCU PPB DPIDB(S)		0		
PPBPDPD	IDCU PPB PER DPIDB RATIO		0.00		
BPPSDEM	IDCU PPB DATA PPS DEMAND			0	
BPPSCAP	IDCU PPB DATA PPS PH CAPACITY			0	
BPPSUTL	IDCU PPB DATA PPS PH UTIL			0	
CUODBI	IDCU ODB USER INFO HEADER	***			
IDCUODB	IDCU ODB USERS		0		
CCSPODB	IDCU WT AVG CCS/ODB USR -DPIDB		0.00		

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PPSPODB IDCU WT AVG DATA PPS/ODB USER 0.00

ODBDPD IDCU ODB DPIDB(S) 0

ODBDPDE IDCU ODB CCS DPIDB DEMAND 0

ODBDPCA IDCU ODB CCS DPIDB CAPACITY 0

ODBDPUT IDCU ODB CCS DPIDB UTL 0

AVGUSPH IDCU ODB AVG USERS/PH - DEMAND 0

ODBASPH IDCU ODB USERS/PH - CAPACITY 0

AVGUSUT IDCU ODB AVG USERS/PH - UTL 0

15.4.2.6.2.5 Office Data Assembler (ODA) Forms

The ODA Forms are used to start up an office in translations. The forms can be referenced to identify the office configuration, but the actual switch verification will show the final office configuration. Detailed information on the ODA Forms/Office Records can be found in the 235-080-100 , *Translation Guide (TG-5)*. The ODA Forms and/or Office Records that can be used are as follows:

Form Number	ODA Form Name	Form Title
Form 5174-1	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
Form 5174-2	rterm	Remote Terminal (TR008) Record - used to define the Channel Unit Type (CUTYPE) equipped in the remote terminal.
Form 5174-4	rterm	Remote Terminal (TR303) - used to define the Remote Terminal IFAC termination, ISCN for the TMC and DPIDB, ISCN for the EOC and DPIDB.

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Form 5741-1 eqpsu Packet Switching Unit Equipage Record - used to define the equipped Packet Switching Unit.

Form 5741-2 eqpsu Packet Switching Unit Equipage Record - used to define the PSU to TSIU Time slots.

Form 5207 nailup Nail-up and Hairpin Specification Record - used to define the OEs.

Form 5742 eqpsuph PSU Protocol Handler Pack Equipage Record - used to define the Protocol Handlers.

Form 5846 eqidcu Integrated Digital Carrier Unit Record - used to define the SM, IDCU, PIDB, and DPIBDs.

Form 5847 eqifac IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.

15.4.2.6.2.6 Office Records

Office records are available on-line at any time on the *5ESS*® switch. Office records are based upon the recent change and verify views of the *5ESS*® switch and are applicable no matter what operational support system is attached to the switch. Office records can be accessed, changed, or input with standard Input/Output (I/O) messages on a message-type terminal. These systems include menu mode and text interface recent change as well as Remote Memory Administration System (RMAS) at the master control center (MCC) in the command (CMD) mode.

Verifying the IDCU office configuration is strongly suggested before definition of your ISDN Line Assignment System. Following is a list of the office records that can be used for the verification.

Refer to Section 15.4.2.6.2.5 , Office Data Assembler (ODA) Forms, for listing of office records form number and description.

Detailed information on the office records can be found in the *Recent Change Manuals* 235-118-XXX documentation and/or the TG-5. Sections 15.4.2.6.3.1 and 15.4.2.6.4.1 identify the recommended office

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records used to determine IDCU office configuration.

15.4.2.6.2.7 Recent Change Views

The RC/V facility is a user interface provided by the *5ESS*® switch that allows users to modify or verify the contents of the office dependent data (ODD) data base on the *5ESS*® switch.

Verifying the ISDN office configuration is strongly suggested. The following is a list of the RC/V Views that can be used:

18.15	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, RT Line Size (TR303), Channel Unit Type (CUTYPE), Remote Terminal IFAC termination, ISCN for the TMC and DPIDB, ISCN for the EOC and DPIDB.
22.2	Packet Switching Unit Equipage Record - used to define the equipped Packet Switching Unit and to define the PSU to TSIU Time slots.
7.11	Nail-up and Hairpin Specification Record - used to define the OEs.
22.4	PSU Protocol Handler Pack Equipage Record - used to define the Protocol Handlers.
19.12	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
20.23	IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.
22.3	Packet Switch Unit Shelf - used to define the Packet Switching Unit Protocol Handlers equipped and the minimum number of spare PHs.
22.16	PSU Protocol Handler Channel Group Assignment - used to define the PH type (PH2 or PH3) and the shelf assignment.

Detailed information on the above Recent Change Views can be found in the *Recent Change Manuals* 235-118-XXX documentation. Section 15.4.2.6.3.1 and 15.4.2.6.4.1 identify the recommended Recent Change Views used to determine IDCU Office Configuration.

15.4.2.6.3 Integrated Digital Carrier Unit (IDCU)

15.4.2.6.3.1 General

This section identifies the questions the administrator should ask to determine the IDCU configuration and the information required to answer those questions. Sample DOPSMOD rtlist, ISDN SM Assignments (ISA report), equipment report and capacity report by IDCU are illustrated with "keyed" values. Items associated with office totals (that is, equipment report, capacity report, and ISA Report) will be identified with "**Item 1**, **Item 3**, etc." and items associated with individual SMs will be identified with "**Item A**, **Item B**, etc.". When all IDCUs are engineered the same, only one equipment report and capacity report is necessary to determine the IDCU configuration for TR008 or TR303 applications, as is the case in our example.

The following rtlist is our sample office and is referenced throughout the TR008 Applications Section 15.4.2.6.3.2 and TR303 Applications Section 15.4.2.6.3.3 :

rtlist

(IDCU-1 SM #1) IDCU-2 NON-ISDN IDCU-3 NON-ISDN IDCU-4 NON-ISDN

TR3-49 TR3-53 TR8-1 TR8-25 TR8-2 TR8-26 TR8-3 TR8-27

TR3-50 TR3-54 TR8-7 TR8-31 TR8-8 TR8-32 TR8-9 TR8-33

TR3-51 TR3-55 TR8-13 TR8-37 TR8-14 TR8-38 TR8-15 TR8-39

TR3-52 TR3-56 TR8-19 TR8-43 TR8-20 TR8-44 TR8-21 TR8-45

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IDCU-5 NON-ISDN IDCU-6 NON-ISDN IDCU-7 NON-ISDN

TR8-4 TR8-28 TR8-5 TR8-29 TR8-6 TR8-30

TR8-10 TR8-34 TR8-11 TR8-35 TR8-12 TR8-36

TR8-16 TR8-40 TR8-17 TR8-41 TR8-18 TR8-42

TR8-22 TR8-46 TR8-23 TR8-47 TR8-24 TR8-48

The rtlist provides a listing of all remote terminals engineered within an IDCU. Obtain the following information from the rtlist report:

SM #1	IDCUs on a specific Loaded SM
NON-ISDN	IDCUs on a Standard SM
IDCU Number	IDCU-1, IDCU-2, IDCU-3, etc.
TR3	Lists TR303 Remote Terminals within an IDCU
TR8	Lists TR008 Remote Terminals within an IDCU
TR8-1-48	TR008 Remote Terminal Number
TR3-49-56	TR303 Remote Terminal Number

NOTE: A total of 48 TR008 RTs matches **Item 2** on the ISA Office Totals Report. In our example office all TR008 IDCUs have been engineered uniformly, so one equipment report, one capacity report, etc. is reflective of IDCU-2 and all other IDCUs.

15.4.2.6.3.2 TR008 Applications

1. Is the IDCU in a Standard or Loaded SM?

The rtlist (reference Section 15.4.2.6.3.1) indicates the TR008 RTs are assigned to Standard SMs. The TR008 may work in a Standard or Loaded SM. No ISA Report is generated when only TR008 IDCUs are assigned to a Standard SM. The DOPSMOD Equipment Report identifies the information needed for the IDCU configuration.

2. What interface is provided on the IDCU: TR008, TR303, PUB43801, or both TR008 and TR303?

TR008 is an *SLC*® 96 type interface for the IDCU. A TR008 IDCU supports *SLC*® 96 RTs, *SLC*® Series 5 RTs with Feature Package B or enhanced Feature Package B, and Feature Package 303G operating in the TR008 mode. Each of the systems listed above may be either Mode I or Mode II. Only analog lines may be assigned in TR008 interfaces.

PUB43801 or non-remote terminals (NRT) are non-switched/switched specials from a D4/D5 Channel Bank to an IDCU via a DS1.

TR303 is addressed in Section 15.4.2.6.3.3 . The following text addresses TR008 equipment quantities.

The DOPSMOD Equipment Report identifies TR008 IDCU-2. Look for the following symbol:
CU008RT TR008 RT(s) IN THIS IDCU 8
Item 1

Notice the 8 RTs in IDCU-2 match the 8 RTs on the rtlist report for IDCU-2.

The DOPSMOD ISA Report - Office Totals identify the number of TR008 RTs (remember the ISA Report is generated when TR008 and TR303 IDCUs are engineered in the office). Look for the following symbol:
TR008 No. of TR008 RTs in IDCUs 48 **Item 2**

Notice the 48 RTs on the ISA Report - Office Totals match the 48 RTs reflected on the rtlist Report for IDCU-2 through IDCU-7.

The DOPSMOD ISA Report - ISDN SM No. 1 identify the quantity of TR008 RTs per IDCU. Look for the following symbol:
TR008 No. of TR008 RTs in IDCUs 0 **Item A**

Notice the quantity of TR008 RTs in our example is 0. The only time the quantity would be different is when the SM has a mixed TR008 and TR303 configuration.

The DOPSMOD ISA Report - Office Totals identifies the total number of PUB43801 assigned to TR008 and TR303 IDCUs using the following symbol:
NRT No. of PUB43801 DS1s in IDCUs 14 **Item 7**

The DOPSMOD Capacity Report identifies the total number of PUB43801 for IDCU-2 using the following symbol:
CUPUDS1 IDCU NRT DS1(S) 2 **Item 8**

Remember, all the IDCUs in the sample office engineered the same. Recall the office is engineered with 6 TR008 IDCUs. Determine the quantity of PUB43801s for TR008 applications as follows:
6 IDCUs (Refer to rtlist) 2 (NRT DS1s per IDCU-2) = 12 NRT DS1s per total

office

Notice the DOPSMOD ISA Office Totals Report, NRT symbol (**Item 7**) indicates there are 14 PUB43801 DS1s. The ISA Office Totals are for both TR008 and TR303 applications. The equation shown above shows there are 12 NRT DS1s. The remaining 2 DS1s are for the TR303 IDCU application.

The DOPSMOD rtlist identifies remote terminals assigned to ISDN and non-ISDN SMs.

Other methods to obtain the interface is provided on the IDCU for TR008 and are as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

3. How many IDCUs are equipped?

A maximum of 7 IDCUs may be present in an SM.

The DOPSMOD rtlist Report identify the total number of IDCUs. In our example rtlist (Section 15.4.2.6.3.1) notice IDCU 1 through 7 are engineered.

The DOPSMOD ISA Report - Office Totals identifies the total number of TR008 and TR303 IDCUs as follows:
IDCU No. of IDCU UNITS 7 **Item 4**

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The number of IDCUs equipped in the SM may also be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

4. How many ELIs are equipped?

The ELI receives the DS1 signals. Each ELI may terminate 20 DS1s. A fully equipped IDCU has two ELI packs, but a partially configured IDCU has one. The ELI splits the signals to the active and loop standby interfaces (LSI). The ELIs also terminate the PIDB clock and synchronization signals for PIDBs 1 through 15. The ELI A terminates PIDBs 1 through 8 and ELI B terminates PIDBs 9 through 15.

The DOPSMOD Equipment Report identifies the quantity of DS1s equipped for IDCU-2. As previously stated, an ELI pack may terminate 20 DS1s thus, one ELI pack is engineered for every 20 DS1s engineered. Look for the following symbol:
IDCU ONE IDCU EQP FOR 20 DS1(s) 1
Item 3

IDCUADL ADD'L 20 DS1(s) FOR ONE IDCU 1 **Item 5**

Remember, all the TR008 IDCUs in our example are engineered the same. So, we are able to use the information found on the equipment report for IDCU-2 and duplicate the equipment configuration for all the other TR008 IDCUs.

The number of ELIs equipped in the SM can also be found as follows:

ODA	eqidcu	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
RC/V	19.12	Same as ODA eqidcu
Office Records	Form 5174-1	Same as ODA eqidcu

5. How many remote terminals are assigned in the IDCU?

The number of RDTs that may be assigned in an IDCU is a function of the total of DS1s used and the number of each type of IDLC interface employed. The *5ESS*® switch software limits the maximum number of RDTs per IDCU to 31.

Refer to question number 2 for the DOPSMOD Reports information. Remember, the DOPSMOD rtlist provides information on the equipped IDCUs and lists all the remote terminals by type for each IDCU.

The number of remote terminals equipped in the IDCU may also be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

6. How many DS1s are equipped per RT? Do you have a protection line?

An IDCU may be arranged for 20 or 40 DS1s. Reference question number 4.

The number of DS1s (IFAC) per remote terminal equipped in the IDCU can also be found as follows:

ODA	eqifac	IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.
RC/V	20.23	Same as ODA eqifac

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Office Records	Form 5847	Same as ODA eqifac

The protection line can be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

7. How many lines can be assigned in the remote terminals, including hairpin and nailup?

The number of lines available for assignment within the remote terminals equipped in the IDCU for TR008 can be found as follows:

The number of lines that can be assigned within a remote terminal is dependent on the vendor's equipment. Check your local practices for guidelines.

The DOPSMOD Capacity Report - IDCU-2 provides the number of TR008 and TR303 lines and the number of hairpin and nailup time slots (each line requires a time slot) that may be assigned. Look for the following symbol:
CULINES IDCU TR008 + TR303 LINES 736 **Item 9**

HPINUTS IDCU HAIRPIN TIME SLOTS 32 **Item 10**

CUPUTS NRT TSI NON-SWITCH SPECIAL TS 0 **Item 11**

Remember, IDCU-2 is a TR008 application, so in our example, all the 736 lines that may be assigned are analog for the office. To determine the number of lines that can be assigned per RT, perform the following equation:
CULINES + HPINUTS + CUPUTS □ 8 RTs per IDCU = Total lines assigned per RT

736 + 32 + 0 □ 8 = 96

The number of lines available for assignment within the remote terminals equipped in the IDCU for TR303 may be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
ODA	nailup	Nail-up and Hairpin Specification Record - used to define the OEs.
RC/V	18.15	Same as ODA rterm
RC/V	7.11	Same as ODA nailup
Office Records	Form 5174-1	Same as ODA rterm
Office Records	Form 5207	Same as ODA nailup

8. What types of services can be deployed from the remote terminal?

The types of lines that can be assigned within a TR008 IDCU are dependent on the cards that are equipped in the *SLC*® unit. Contact your outside plant engineer to obtain the type of cards equipped in the *SLC*® unit or the card types can be found as follows:

ODA	rterm	Remote Terminal (TR008) Record - used to define the Channel Unit Type (CUTYPE) equipped in the remote terminal.
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-2	Same as ODA rterm

9. How many loop side interfaces are equipped?

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The LSI receives the DS1 signals. Four LSIs are provided in fully equipped IDCUs: two active and two standby. The LSI converts the DS1 to PIDB-like format on the internal bus to the PIDB transmission interface (PTI). The PIDB is the connection from peripheral units to the time slot interchange (TSI) in the *5ESS*® switch. There are 32 time slots per PIDB.

The number of LSIs equipped in the IDCU can also be found as follows:

ODA	eqifac	IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.
RC/V	20.23	Same as ODA eqifac
Office Records	Form 5847	Same as ODA eqifac

10. How many PIDBs are equipped?

The PTI contains a TSI function, thus enabling the DS0 time slot to be connected to any PIDB/DPIDB time slot. A maximum of 16 PIDBs is permitted. The sum of PIDBs plus two times the DPIDBs must not exceed 30.

The PIDBs for an IDCU are arranged in two service groups, an active group and a standby group. Each group can contain up to 23 (D)PIDBs. The number of PIDBs required is a function of an IDCUs circuit-switched traffic usage.

An IDCU service group can be configured for 15 PIDBs when installed in a Standard SM. Since an IDCU must have a standby for each of its active PIDBs, a maximum of 15 active and 15 standby PIBDs can be assigned to all of the IDCUs in an SM. A total of 31 PIDBs are available in an SM. The 31 PIDBs in the SM are reserved for pumping an SM.

The DOPSMOD Equipment Report identifies the number of PIDBs equipped for IDCU-2. Remember, all the other TR008 IDCUs in our example are configured the same. Look for the following symbol:
PIDB TSIU PIDB(s)/IDCU 6 **Item 6**

The PIDBs configuration equipped in the SM can also be found as follows:

ODA	eqidcu	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
RC/V	19.12	Same as ODA eqidcu
Office Records	Form 5174-1	Same as ODA eqidcu

11. How many time slots sets are engineered per IDCU?

The number of time slots sets (TSS) engineered per IDCU is determined by dividing the number of engineered PIDBs by 4 (4 PIDBs equal one TSS). Question 10 identifies the reports where the engineered PIDBs may be found. The sample Equipment Report shows 6 PIDBs are engineered for IDCU-2. In our sample office, the number of TSSs engineered is 1+. (6 PIDBs divided by 4 PIDBs per TSSs).

12. What is the capacity of the IDCU?

The DOPSMOD Capacity Report has a wealth of information that can be used to aid in administration of your IDCU. The capacity report tells you the engineering criteria used, for example, average busy season or high day, per cent blocking, line concentration ratio, number of hair pin time slots, CCS capacity, etc. More detail information can be found in the 235-060-110 *5ESS*® *Switch Engineering Practice*.

Sample Equipment Report for a TR008 Application:

5ESS Switch Engineering System

EQUIPMENT REPORT

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = idcu-2

ORDNO = 12345 STATE = sto XGEN = 9.10

DOPSMOD

SYMBOL	DOPSMOD TITLE	PRESENT	ADDL	DEF	PROPOSED	
CU008RT	TR008 RT(S) IN THIS IDCU	0	8		8	Item 1
PIDB	TSIU PIDB(S)/IDCU	0	6		6	Item 6
IDCU	ONE IDCU EQP FOR 20 DS1(S)	0	1		1	Item 3
IDCUADL	ADD'L 20 DS1(S) FOR ONE IDCU	0	1		1	Item 5

Sample DOPSMOD ISA report for TR008 and TR303 Applications:

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = ISDN

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ORDNO = 12345 STATE = sto XGEN = 9.10

OFFICE TOTALS

		ISLU	IDCU
CCSPTSM	HD WEIGHTED AVG CCS / BRI/DSL CARD	2.02	
BRITCRD	BRI T LINE CARDS	0	
U2B1QCD	BRI 2B1Q U LINE CARDS	0	
UAMICD	BRI/DSL AMI U LINE CARDS	0	
ZCRD	Z LINE CARDS	0	
TUZCRD	TOTAL LINE CARDS / IDCU LINES	0	5152
TR303	NO. OF TR303 RTs IN IDCUs	8	
TR008	NO. OF TR008 RTs IN IDCUs	48	Item 2*
NRT	NO. OF PUB43801 DS1s IN IDCUs	14	Item 7
DPPS	WEIGHTED AVG PPS / D-CHANNEL	0.02	
PPB	NO. OF PERM. PKT B-CHANNELS	0	8
PPBPPS	PERM. PKT B PEAK PPS PER PPB	0.00	20.00
ODB	NO. OF ON-DEMAND B USERS	0	0
ODBCCS	DPIDB OCCUPANCY CCS PER ODB	0.00	0.00
ODBPPS	ON-DEMAND B PEAK PPS PER ODB	0.00	0.00
PH2SPR	NO. SPARE PH2 / PSU SHELF	1	
PH3SPR	NO. SPARE PH3 / PSU SHELF	1	
XISTF	ISTF OPTION (YES / NO)	n	
IDCU	NO. OF IDCU UNITS	7	Item 4
XSPLFCT	UNIFORM INTER-SM CONN. FACTOR	1.20	
BRIPLGC	BRI/DSL CARDS / LINE GRP CNTRLR	0	
MAXPIDB	MAXIMUM PIDBS AT THIS CCS-ISLU	0	

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BRILGC NO. LGC REQD FOR BRI/DSL - ISLU 0

ISDNSM NUMBER OF ISDN SMS REQUIRED 1

DLTUSM NUMBER OF ISDN SMS WITH DLTU 0

* Note: No. of TR008 RTs in IDCUs; 48, matches the total number of RTs on the rtlist.

Remember the ISA report is generated when both TR008 and TR303 are engineered at the same site (central office).

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = ISDN

ORDNO = 12345 STATE = sto XGEN = 9.10

ISDN SM No. 1

Summary		ISLU Qty PH	IDCU Qty PH
CCSPTSM	HD WEIGHTED AVG CCS / BRI/DSL CARD	2.02	
BRITCRD	BRI/DSL T LINE CARDS	0	
U2B1QCD	BRI/DSL 2B1Q U LINE CARDS	0	
UAMICD	BRI/DSL AMI U LINE CARDS	0	

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ZCRD Z LINE CARDS 0

TUZCRD TOTAL LINE CARDS / IDCU LINES 0 736 (3)

TR303 NO. OF TR303 RTs IN IDCUs 8

TR008 NO. OF TR008 RTs IN IDCUs 0 Item A*

NRT NO. OF PUB43801 DS1s IN IDCUs 2

PPB NO. OF PERM. PKT B-CHANNELS 0 8 (3)

PPBPPS PERM. PKT B PEAK PPS PER PPB 0.00

DPPS WEIGHTED AVG PPS / D-CHANNEL 0.02

ODB NO. OF ON-DEMAND B USERS 0 0

ODBCCS DPIDB OCCUPANCY CCS PER ODB 0.00

ODBPPS ON-DEMAND B PEAK PPS PER ODB 0.00

PH2RAT PH2 PER DPIDB (1/4 ISLU BASIS) 0.00

PH3RAT PH3 PER DPIDB (1/4 ISLU BASIS) 0.00

ISMPH AVG INTER-SM PROTOCOL HANDLERS 0 EST.(ON PH3) 0 ASGN

PSUSHVS NO. PSU SHELVES IN THE ISDN SM 1

DSU2IF QTY OF ISTF PACKS ON DSU-2 0

IDCU NO. OF IDCU UNITS 1

RPATS RESERVED RPA/RPM T.S. PER SHF 0

INSMPPS EST. PPS FOR INTER-SM PKT TPT 0

SM PIDB and LG breakdown PIDBs LGs

IDCU# 1 6

SUM PIDBs 6

SUM LGs 0

* Note there will not be any value for TR008 since they are assigned in a

Standard SM in our example.

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = ISDN

ORDNO = 12345 STATE = sto XGEN = 9.10

IDCU PROTOCOL HANDLER ASSIGNMENTS

IDCU# 1 -- X.25B -- -------- PSU ----------

PIDB	DPIDB	PPB	ODB	PH2	PH3	shelf	port
6	A (0)	0	0	0.00	1.00	0	a
	B (1)	0	0	0.00	1.00	0	b
	C (2)	0	0	0.00	1.00	0	c
	D (3)	0	0	0.00	1.00	0	d
	E (4)	0	0	0.00	0.00		
	F (5)	0	0	0.00	0.00		
	G (6)	0	0	0.00	0.00		
	H (7)	0	0	0.00	0.00		
	I (8)	0	0	0.00	0.00		
	J (9)	0	0	0.00	0.00		
	K (10)	0	0	0.00	0.00		

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IDCU# 1 PROT ISDN ANALOG PIDB

RT# TR IDENTIFIER DS1 LINE LINES LINES USERS NUTS

49 303 4 0 20 72 20 0

50 303 4 0 20 72 20 0

51 303 4 0 20 72 20 0

52 303 4 0 20 72 20 0

53 303 4 0 20 72 20 0

54 303 4 0 20 72 20 0

55 303 4 0 20 72 20 0

56 303 4 0 20 72 20 0

NRT PUB 2 0

PSU# 1 PROTOCOL HANDLER ASSIGNMENTS

DPIDB port - ism - trk/cnl spare total

sf a(0)__ b(1)__ c(2)__ d(3)__ e(4)__ f(5) p2 p3 ts p2 p3 p2 p3 p2 p3 sum

4 0.00 0.00 0.00 0.00 0.00 0.00 0 0 0 0 0 0 0 0 0 0 0 0

3 0.00 0.00 0.00 0.00 0.00 0.00 0 0 0 0 0 0 0 0 0 0 0 0

2 0.00 0.00 0.00 0.00 0.00 0.00 0 0 0 0 0 0 0 0 0 0 0 0

1 0.00 0.00 0.00 0.00 0.00 0.00 0 0 0 0 0 0 0 0 0 0 0 0

0 1.00 1.00 1.00 1.00 0.00 0.00 0 0 0 0 0 0 1 0 5 5

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = ISDN

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```
ORDNO = 12345        STATE   = sto              XGEN      = 9.10
--------------------------------------------------------------------------------

 Active PIDBs + DPIDBs for IDCU# 1 =  11
 Total IDCU to TSIU PIDB Ports        6
 Remaining TSIU Ports                23

 ISLU PIDB TS         0    Reserved TS for NXDS0      0
 IDCU PIDB TS         96   Spare TS for any unit -->  414
 ISTF TS              0    PSU TS demand              0
 DLTU TS              0    Available TS for PSU only  0
 Inter-SM TS          0    IDCU Nail-up TS for TSIU   0
 Packet Trunk TS for PSU      0    Used Nail-up TS for TSIU   0
 Recovered DLTU TS            (0)  Avail Nail-up TS for TSIU  190
```

Sample Capacity Report for TR008 Application:

```
                5ESS Switch Engineering System

                     CAPACITY REPORT

ISSUE:  16.00  VERSION:  2                    DATE: 21FEB94 @ 13:18 CST

--------------------------------------------------------------------------------

NPA   = 303          LD     = Base Load Division   LOCATION  = domestic

CLLI  = grfngama22c  TYPE   = host             CATEGORY  = idcu-2

ORDNO = 12345        STATE  = sto              XGEN      = 9.10

--------------------------------------------------------------------------------

 DOPSMOD

SYMBOL    5 DOPS TITLE                    QTY    DEMAND   CAPACITY  %UTL
```

IDCUHD IDCU TCBH HD TO ABS RATIO 1.00

IDCUBLK PCT BLOCKING ON IDCU 1.50

ABSCCS WT AVG DS1 ABS NON-NU CCS/LINE 3.50

HDCCS WT AVG DS1 HD NON-NU CCS/LINE 3.50

PTSLCR IDCU CIRCUIT SWITCHED LCR 8.00

CULINES IDCU TR008 + TR303 LINES 736 Item

CURTDS1 IDCU RT DS1 MINUS PROT LINES 32

CUTSHR IDCU RT TIME SLOT INFO HEADER ***

DS1TSD TR008 + TR303 DS1 TIME SLOT DE 124

CSTSD TR008/TR303 CKT SW AND ODB TS 92

PPDNUTS TR303 PPD TIME SLOTS 0

PPBNUTS TR303 PPB TIME SLOTS 0

TSINUTS TR008+TR303 TSI NON-SW SPC TS 0

HPINUTS IDCU HAIRPIN TIME SLOTS 32 Item 10

MTCETS TR003 EOC/TMC TIME SLOTS 0

DS1TSC TR008+TR303 DS1 TIME SLOT CAP 768

DS1TSU TR008+TR303 DS1 TIME SLOT UTL 17

CUPUDS1 IDCU NRT DS1(S) 2 Item 8

CUPUTS NRT TSI NON-SWTCH SPECIAL TS 0 Item 11

PITSDEM IDCU PIDB TIME SLOT DEMAND 92

PITSCAP IDCU PIDB TIME SLOT CAPACITY 96

PITSUTL IDCU PIDB TIME SLOT UTL 96

CUUSGHR IDCU USAGE INFO HEADER ***

CUCCSDE IDCU PIDB WT. AVG. CCS/LINE DE 3.50

CUCCSCA IDCU PIDB CCS/LINE CAPACITY 5

CUCCSUT IDCU PIDB CCS/LINE UTL 70

IDCUTD IDCU PIDB LINE DEMAND 736

IDCUTC IDCU PIDB LINE CAPACITY 768

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IDCUTU IDCU LINE UTL 96

CUUSGTD IDCU PIDB USAGE DEM - LINES 736

CUUSGTC IDCU PIDB USAGE CAP - LINES 889

CUUSGCD IDCU PIDB USAGE DEMAND - CCS 2576

CUUSGCC IDCU PIDB USAGE CAP - CCS 3111

CUUSGU IDCU USAGE UTL 83

IDCUMLU IDCU MOST LIMIT - USG (ABS,HD) abs

IDCUML IDCU MOST LIMIT - (USG, LINES) lines

IDCUMLC IDCU ML CAPACITY IN LINES 768

CUDCHI IDCU D-CHAN PKT INFO HEADER ***

CUPKTLN IDCU ISDN LINES 0

CUDPPS IDCU WT. AVG. D-CH DATA PPS/LN 0.00

DCHDPD IDCU D-CHAN DPIDB(S) 0

DCHPDPB IDCU D-CHAN PER DPIDB RATIO 0.00

DPPSDEM IDCU D-CHAN DPPS DEMAND 0

5ESS Switch Engineering System

CAPACITY REPORT

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = idcu-2

ORDNO = 12345 STATE = sto XGEN = 9.10

DOPSMOD

SYMBOL 5 DOPS TITLE QTY DEMAND CAPACITY %UTL

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DPPSCAP	IDCU D-CHAN DPPS PH CAPACITY		0		
DPPSUT	IDCU D-CHAN DPPS PH UTIL.			0	
CUPPBI	IDCU PPB PKT INFO HEADER	***			
IDCUPPB	IDCU PPB CHANNELS	0			
CUBPPS	IDCU WT. AVG. PPB DATA PPS/LN	0.00			
PPBDPD	IDCU PPB DPIDB(S)	0			
PPBPDPD	IDCU PPB PER DPIDB RATIO	0.00			
BPPSDEM	IDCU PPB DATA PPS DEMAND		0		
BPPSCAP	IDCU PPB DATA PPS PH CAPACITY			0	
BPPSUTL	IDCU PPB DATA PPS PH UTIL				0
CUODBI	IDCU ODB USER INFO HEADER	***			
IDCUODB	IDCU ODB USERS	0			
CCSPODB	IDCU WT AVG CCS/ODB USR -DPIDB	0.00			
PPSPODB	IDCU WT AVG DATA PPS/ODB USER	0.00			
ODBDPD	IDCU ODB DPIDB(S)	0			
ODBDPDE	IDCU ODB CCS DPIDB DEMAND		0		
ODBDPCA	IDCU ODB CCS DPIDB CAPACITY			0	
ODBDPUT	IDCU ODB CCS DPIDB UTL				0
AVGUSPH	IDCU ODB AVG USERS/PH - DEMAND		0		
ODBASPH	IDCU ODB USERS/PH - CAPACITY			0	
AVGUSUT	IDCU ODB AVG USERS/PH - UTL				0

15.4.2.6.3.3 TR303 Applications

1. Is the IDCU in a Standard or Loaded SM?

The rtlist (reference Section 15.4.2.6.3.1) indicates the TR303 RT is assigned to a Loaded SM. TR303 works only in a Loaded SM. An ISA report is generated for TR303 IDCUs.

2. What interface is provided on the IDCU: TR008, TR303, PUB43801, or both TR008 and TR303?

The TR008 is addressed in Section 15.4.2.6.3.2 .

The TR303 is a generic interface for the IDCU system. The major advantage for a generic interface is that it allows operating companies to mix remote digital terminals and local digital switches from different vendors. Analog and ISDN lines can be assigned in TR303 interfaces. TR303 requires a Loaded SM.

PUB43801 or non-remote terminals (NRT) are non-switched/switched specials from a D4/D5 Channel Bank to an IDCU via a DS1.

The DOPSMOD Equipment Report for IDCU-1 identifies TR303 using the following symbol:
CU303RT TR303 RT(S) IN THIS IDCU 8
Item 1

Notice the 8 RTs (see above) in IDCU-1 match the 8 RTs on the rtlist Report for IDCU-1.

The DOPSMOD ISA Report - Office Totals identify the quantity of TR303 RTs using the following symbol:
TR303 No. of TR303 RTs in IDCUs 8
Item 2

Notice the 8 RTs on the ISA Report - Office Totals match the 8 RTs reflected on the rtlist Report for IDCU-1.

The DOPSMOD ISA Report - ISDN SM No 1 identify TR303 using the following symbol:
TR303 No. of TR303 RTs in IDCUs 8
Item A

The DOPSMOD ISA Report - Office Totals identify the total number of PUB43801 assigned to TR008 and TR303 IDCUs using the following symbol:
NRT No. of PUB43801 DS1s in IDCUs 14 **Item 3**

The DOPSMOD ISA Report - ISDN SM No.1 identify the number of PUB43801 assigned to TR303 IDCUs using the following symbol:
NRT No. of PUB43801 DS1s in IDCUs 2 **Item B**

The DOPSMOD rtlist identifies ISDN and non-ISDN remote terminals. The DOPSMOD Capacity Report identifies the total number of PUB43801 for IDCU-1 using the following symbol:
CUPUDS1 IDCU NRT DS1(S) 2
Item 8

Other methods to obtain the interface is provided on the IDCU; TR303, and PUB43801 are as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

3. How many IDCUs are equipped?

A maximum of 7 IDCUs can be present in an SM.

The DOPSMOD ISA Report - Office Totals identifies the total number of TR008 and TR303 IDCUs as

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follows:
IDCU No. of IDCU UNITS 7
Item 5

The DOPSMOD ISA Report - ISDN SM No 1 identifies TR303 IDCUs in a SM as follows:
IDCU No. of IDCU UNITS 1
Item C

The DOPSMOD rtlist Report identifies the total number of IDCUs. In our example rtlist (Section 15.4.2.6.3.1) notice IDCU 1 through 7 are engineered. IDCU-1 is engineered for TR303.

Notice the quantity of IDCUs on the rtlist matches the quantity of IDCUs on the ISA Office Total Report. IDCU-1 is assigned to an ISDN SM.1.

The number of IDCUs equipped in the SM can also be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

4. How many ELIs are equipped?

The ELI receives the DS1 signals. Each ELI can terminate 20 DS1s. A fully equipped IDCU has two ELI packs, but a partially configured IDCU has one. The ELI splits the signals to the active and loop standby interfaces (LSI). The ELIs also terminate the PIDB clock and synchronization signals for PIDBs 1 through 15. ELI A terminates PIDBs 1 through 8 and ELI B terminates PIDBs 9 through 15.

The DOPSMOD Equipment Report identifies number of ELIs equipped per IDCU. Look for the following symbol:
IDCU ONE IDCU EQP FOR 20 DS1(s)
Item 4

IDCUADL ADD'L 20 DS1(s) FOR ONE IDCU **Item 6**

The number of ELIs equipped in the SM can also be found as follows:

ODA	eqidcu	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
RC/V	19.12	Same as ODA eqidcu
Office Records	Form 5174-1	Same as ODA eqidcu

5. How many remote terminals are assigned in the IDCU?

The number of RDTs that can be equipped in an IDCU is a function of the total quantity of DS1s used and the quantity of each type of IDLC interface employed. The *5ESS*® switch software limits the maximum number of RDTs per IDCU to 31.

The DOPSMOD ISA Report - Office Totals identifies the office total number of TR303 RTs using the following symbol:
TR303 No. of TR303 RTs in IDCUs 8 **Item 1**

The DOPSMOD ISA Report - ISDN SM No 1 identifies the number of TR303 RTs per SM using the following symbol:

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TR303 No. of TR303 RTs in IDCUs 8 **Item A**

The DOPSMOD rtlist provides information on the engineered RTs per IDCUs.

The number of remote terminals equipped in the IDCU can be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

6. How many DS1s are equipped per remote terminal? Do you have a protection line?

An IDCU can be arranged for 20 or 40 DS1s. This quantity minus the DS1s used for PUB43801 applications is the number of DS1s available for IDCU systems and indirectly limits the number of RDTs that can be served.

The DOPSMOD Equipment Report identifies the number of DS1s provisioned for IDCU-1 as follows:
IDCU ONE IDCU EQP FOR 20 DS1(S) 1
Item 4

IDCUADL ADD'L 20 DS1(S) FOR ONE IDCU 1 **Item 6**

The DOPSMOD ISA Report - ISDN SM No 1 identifies the number of DS1s per remote terminal (**Item D**) and protection line(**Item E**).

The number of DS1s (IFAC) per remote terminal equipped in the IDCU can also be found as follows:

ODA	eqifac	IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.
RC/V	20.23	Same as ODA eqifac
Office Records	Form 5847	Same as ODA eqifac

The protection line can be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

7. How many lines can be assigned in the remote terminals, including hairpin and nailup?

The number of lines that can be assigned within a remote terminal is dependent on the version of IDCU; TR008 or TR303 and the vendor's equipment. The IDCU allows 1 to 2048 lines per remote terminal. Check your local practices for guidelines.

The DOPSMOD ISA Report - ISDN SM No 1 identifies the number of Analog Lines (**Item F**), ISDN Lines (**Item G**), and Users (**Item H**).

The DOPSMOD Capacity Report - IDCU-1 provides the number of TR008 and TR303 lines and the number of hairpin and nailup time slots (each line requires a time slot) that may be assigned. Look for the following symbol:
CULINES IDCU TR008 + TR303 LINES 736 **Item 7**

HPINUTS IDCU HAIRPIN TIME SLOTS 32 **Item 9**

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CUPUTS NRT TSI NON-SWITCH SPECIAL TS 0 **Item 10**

IDCU-1 is a TR303 application. In our example, the 736 lines may be assigned analog and/or ISDN for the IDCU. To determine the number of lines that can be assigned per RT, perform the following equation:
CULINES + HPINUTS + CUPUTS □ 8 RTs per IDCU = Total lines assigned per RT

736 + 32 + 0 □ 8 = 96

The number of lines equipped for assignment within the remote terminals equipped in the IDCU for TR303 can also be found as follows:

ODA	rterm	Remote Terminal (TR008, TR303) Record - used to define SM, IDCU Unit Number, RT Interface (TR008 and TR303), RT Vendor, and RT Line Size (TR303).
RC/V	18.15	Same as ODA rterm
Office Records	Form 5174-1	Same as ODA rterm

8. What types of services can be deployed from the remote terminal?

The types and quantities of lines that are to be assigned within the IDCU can be found on the ISA Report. (**Item F, G, and H**).

The types of lines available for assignment within the remote terminals equipped in the IDCU for TR303 can also be found as follows:

ODA	rterm	Remote Terminal (TR008) Record - used to define the Channel Unit Type (CUTYPE) equipped in the remote terminal.
RC/V	18.15	Same as ODA rterm

9. How many Loop Side Interfaces (LSI) are equipped?

The LSI receives the DS1 signals. Four LSIs are provided in fully equipped IDCUs: two active and two standby. The LSI converts the DS1 to PIDB-like format on the internal bus to the PIDB transmission interface (PTI). The PIDB is the connection from peripheral units to the time slot interchange (TSI) in the *5ESS*® switch. There are 32 time slots per PIDB.

The number of LSIs equipped in the IDCU can also be found as follows:

ODA	eqifac	IDCU Facility Equipment (IFAC) - used to define the connection between the IDCU and the Remote Terminal or PUB.
RC/V	20.23	Same as ODA eqifac
Office Records	Form 5847	Same as ODA eqifac

10. How many PIDBs are equipped?

The PTI contains a TSI function, thus enabling the DS0 time slot to be connected to any PIDB/DPIDB time slot. A maximum of 16 PIDBs is permitted. The sum of PIDBs plus two times the number of DPIDBs must not exceed 30.

The PIDBs for an IDCU are arranged in two service groups, an active group and a standby group. Each group can contain up to 23 (D)PIDBs. The number of PIDBs required is a function of an IDCU circuit-switched traffic usage.

An IDCU service group can be configured for 14 PIDBs when installed in an ISDN SM. Since an IDCU must have a standby for each of its active PIDBs, a maximum of 14 active and 14 standby PIDBs can be assigned to all of the IDCUs in an ISDN SM. The reason it is limited to 14 active and 14 standby PIDBs is

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due to the PSU Shelf PIDB assignment which also requires a mirror image on the TSIU. Thus, an ISDN SM equipped with one or more IDCUs may not exceed 7 TSSs. A total of 31 PIDBs are available in an SM. PIDB 31 in the SM is reserved for pumping an SM.

The DOPSMOD Equipment Report identifies the number of PIDBs per IDCU. Look for the following symbol:
PIDB TSIU PIDB(s)/IDCU 6
Item 11

The DOPSMOD ISA Report - ISDN SM No 1 identifies the number of PIDBs equipped per IDCU(**Item I** and **Item J**).

The PIDBs configuration equipped in the SM can also be found as follows:

ODA	eqidcu	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
RC/V	19.12	Same as ODA eqidcu
Office Records	Form 5174-1	Same as ODA eqidcu

11. How many time slots sets are engineered per IDCU?

The number of time slots sets (TSS) engineered per IDCU is determined by dividing the number of engineered PIDBs by 4 (4 PIDBs equal one TSS). Question 10 identifies the reports where the engineered PIDBs may be found. The sample Equipment Report shows 6 PIDBs are engineered for IDCU-1. In our sample office, the number of TSSs engineered is 1+. (6 PIDBs divided by 4 PIDBs per TSSs).

12. How many DPIDBs are equipped?

The number of DPIDBs is a function of the quantities of U-DSLs (D-channels), provisioned B-channels, on-demand B-channels, and TR-303 RDTs (EOCs and TMCs).

The equipped DPIDBs can be found on the DOPSMOD Equipment Report as follows:
DPAPH3 PH3(S) ASSOCIATED WITH DPIDB-A

DPBPH3 PH3(S) ASSOCIATED WITH DPIDB-B

DPCPH3 PH3(S) ASSOCIATED WITH DPIDB-C **Item 12**

DPDPH3 PH3(S) ASSOCIATED WITH DPIDB-D

The DOPSMOD ISA Report - ISDN SM No 1 identifies the DPIDB (**Item K**), PSU Shelf (**Item L**), and Port (**Item M**).

The DPIDBs configuration equipped in the SM can also be found as follows:

ODA	eqidcu	Integrated Digital Carrier Unit Record - used to define the SM, IDCU, ELI, PIDB, and DPIBDs.
RC/V	19.12	Same as ODA eqidcu
Office Records	Form 5174-1	Same as ODA eqidcu

13. What is the capacity of the IDCU?

The DOPSMOD Capacity Report has a wealth of information that can be used to aid in administration of your IDCU. The capacity report will tell you the engineering criteria used, for example, average busy season or high day, per cent blocking, line concentration ratio, number of hair pin time slots, CCS capacity, etc. More detail information can be found in the 235-060-110, *5ESS® Switch Engineering*

Practice.

15.4.2.6.4 Packet Switch Unit (PSU)

15.4.2.6.4.1 General

This section identifies the questions to ask to determine the configuration of the PSU and where to find the information. The PSU is the same unit used for ISLUs and may be shared with IDCUs. Lucent recommends allocating separate protocol handlers for IDCU and ISDN, and by D-Channel, PPB, PDB, etc.

1. How many shelves are equipped?

The Packet Switch Unit (PSU) has five shelves. The PSU Shelves are numbered 0 to 5. It is not necessary to equip all the shelves in the PSU. The number of shelves equipped in the PSU can be found on the ISDN SM NO. 1 page of the ISA report. The symbol to look for is as follows:
PSUSHVS NO. PSU SHELVES IN THE ISDN SM **Item O**

Item L indicates the actual PSU shelf number that is to be assigned.

Other methods to obtain the equipped PSU shelves are as follows:

ODA	eqpsu	Used to define the equipped PSU shelves.
RC/V	22.3	Same as ODA eqpsu
Office Records	Form 5941	Same as ODA eqpsu

2. How many PHs are equipped per shelf?

A PSU may be equipped with up to 16 PHs. The PHs are engineered for specific functions such as Access PHs (PPB, ODB,, ISLU, RISLU, and IDCU), PRI (Primary Rate Interface), IP (Internal Protocol), ISM (Interswitch Module Link), XAT, trunking for X.75, and X.75'. Protocol handlers are to be used for the function they were engineered. When capacity issues warrant the reallocation of the PH type, the traffic engineer MUST be notified (**Item P**).

The ISM PHs are dedicated for packet links between SMs. The interswitch packet trunk (ISPT) PHs are dedicated to trunks between the *5ESS*® switch and the public packet network switch. Spare PHs are reserved for maintenance and reliability functions.

The OFFICE TOTALS page of the ISA report provides the amount of trunks, XAT channels, ISMs, and PRIs the office was engineered to handle. Each of the X.75, X.75P, IP, XAT, and PRI requires a protocol handler assignment.

Look for the following symbols in DOPSMOD:

PRI	Number of PRID Channels
XAT	Number of XAT Channels
IP	Number of IP Trunks
X75	Number of X75 Trunks
X75P	Number of X75 Prime Trunks
ISM	Number of ISM Trunks

The TRUNK/CHANNEL PROTOCOL HANDLER ASSIGNMENTS page of the ISA report indicates the amount of PHs engineered for the "trunking" types and the PSU shelf they are to be located in. It is extremely important to allocate the PHs by type and PSU shelf assignment since other resources may be used as nailed-up time slots.

The PROTOCOL HANDLER ASSIGNMENTS page of the ISA Report indicates the amount of PHs

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engineered for Access (voice and packet services assigned to BRI/DSLs, packet trunks, Interswitch Module Links (ISM), and spare). Other methods to obtain the number of equipped PIDBs per ISLU Half and/or IDCU are as follows:

ODA	eqpsuph	Used to define the equipped Packet Switch Unit protocol handlers.
RC/V	22.16	Same as ODA eqpsu
Office Records	Form 5742	Same as ODA eqpsu

Sample DOPSMOD Equipment Report for TR303 Application:

5ESS Switch Engineering System

EQUIPMENT REPORT

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NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = idcu-1

ORDNO = 12345 STATE = sto XGEN = 9.10

DOPSMOD

SYMBOL 5 DOPS TITLE PRESENT ADDL DEF PROPOSED O

_____ _____ _____ _____ _____ _____ ___

CU303RT TR303 RT(S) IN THIS IDCU 0 8 8 Item 1

PIDB TSIU PIDB(S)/IDCU 0 6 6 Item 11

PPBX25D PPB CHANNELS ON DPIDB-D 0 8 8

DPAPH3 PH3(S) ASSOCIATED WITH DPIDB-A 0.00 1.00 1.00

DPBPH3 PH3(S) ASSOCIATED WITH DPIDB-B 0.00 1.00 1.00 Item 12

DPCPH3 PH3(S) ASSOCIATED WITH DPIDB-C 0.00 1.00 1.00

DPDPH3 PH3(S) ASSOCIATED WITH DPIDB-D 0.00 1.00 1.00

IDCU ONE IDCU EQP FOR 20 DS1(S) 0 1 1 Item 4

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IDCUADL ADD'L 20 DS1(S) FOR ONE IDCU 0 1 1 Item 6

Sample DOPSMOD ISA Report for TR008 and TR303 Applications:

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

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NPA = 303 LD = Base Load Division LOCATION = domestic

CLII = grfngama22c TYPE = host CATEGORY = ISDN

ORDNO = 12345 STATE = sto XGEN = 9.10

OFFICE TOTALS

ISLU IDCU

CCSPTSM HD WEIGHTED AVG CCS / BRI/DSL CARD 2.02

BRITCRD BRI/DSL T LINE CARDS 0

U2B1QCD BRI/DSL 2B1Q U LINE CARDS 0

UAMICD BRI/DSL AMI U LINE CARDS 0

ZCRD Z LINE CARDS 0

TUZCRD TOTAL LINE CARDS / IDCU LINES 0 5152

TR303 NO. OF TR303 RTs IN IDCUs 8 Item 2

TR008 NO. OF TR008 RTs IN IDCUs 48

NRT NO. OF PUB43801 DS1s IN IDCUs 14 Item 3

DPPS WEIGHTED AVG PPS / D-CHANNEL 0.02

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PPB NO. OF PERM. PKT B-CHANNELS 0 8

PPBPPS PERM. PKT B PEAK PPS PER PPB 0.00 20.00

ODB NO. OF ON-DEMAND B USERS 0 0

ODBCCS DPIDB OCCUPANCY CCS PER ODB 0.00 0.00

ODBPPS ON-DEMAND B PEAK PPS PER ODB 0.00 0.00

PH2SPR NO. SPARE PH2 / PSU SHELF 1

PH3SPR NO. SPARE PH3 / PSU SHELF 1

XISTF ISTF OPTION (YES / NO) n

IDCU NO. OF IDCU UNITS 7 Item 5

XSPLFCT UNIFORM INTER-SM CONN. FACTOR 1.20

BRIPLGC BRI/DSL CARDS / LINE GRP CNTRLR 0

MAXPIDB MAXIMUM PIDBS AT THIS CCS-ISLU 0

BRILGC NO. LGC REQD FOR BRI/DSL - ISLU 0

ISDNSM NUMBER OF ISDN SMS REQUIRED 1

DLTUSM NUMBER OF ISDN SMS WITH DLTU 0

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

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ORDNO = 12345 STATE = sto XGEN = 9.10

ISDN SM No. 1

ISLU IDCU

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Summary Qty PH Qty PH

CCSPTSM HD WEIGHTED AVG CCS / BRI/DSL CARD 2.02

BRITCRD BRI/DSL T LINE CARDS 0

U2B1QCD BRI/DSL 2B1Q U LINE CARDS 0

UAMICD BRI/DSL AMI U LINE CARDS 0

ZCRD Z LINE CARDS 0

TUZCRD TOTAL LINE CARDS / IDCU LINES 0 736 (3)

TR303 NO. OF TR303 RTs IN IDCUs 8 Item A

TR008 NO. OF TR008 RTs IN IDCUs 0

NRT NO. OF PUB43801 DS1s IN IDCUs 2 Item B

PPB NO. OF PERM. PKT B-CHANNELS 0 8 (3)

PPBPPS PERM. PKT B PEAK PPS PER PPB 0.00

DPPS WEIGHTED AVG PPS / D-CHANNEL 0.02

ODB NO. OF ON-DEMAND B USERS 0 0

ODBCCS DPIDB OCCUPANCY CCS PER ODB 0.00

ODBPPS ON-DEMAND B PEAK PPS PER ODB 0.00

PH2RAT PH2 PER DPIDB (1/4 ISLU BASIS) 0.00

PH3RAT PH3 PER DPIDB (1/4 ISLU BASIS) 0.00

ISMPH AVG INTER-SM PROTOCOL HANDLERS 0 EST.(ON PH3) 0 ASGN

PSUSHVS NO. PSU SHELVES IN THE ISDN SM 1 Item O

DSU2IF QTY OF ISTF PACKS ON DSU-2 0

IDCU NO. OF IDCU UNITS 1 Item C

RPATS RESERVED RPA/RPM T.S. PER SHF 0

INSMPPS EST. PPS FOR INTER-SM PKT TPT 0

Item I

SM PIDB and LG breakdown PIDBs LGs

IDCU# 1 6

SUM PIDBs 6

SUM LGs 0

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

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IDCU PROTOCOL HANDLER ASSIGNMENTS

IDCU# 1 Item K -- X.25B -- ----- PSU ----------

Item J	PIDB	DPIDB	PPB	ODB	PH2	PH3	shelf port
6 A (0)	0	0	0.00	1.00	0	a	
B (1)	0	0	0.00	1.00	0	b	
C (2)	0	0	0.00	1.00	0	c	
D (3)	8	0	0.00	1.00	0	d	
E (4)	0	0	0.00	0.00	Item L	Item M	
F (5)	0	0	0.00	0.00			
G (6)	0	0	0.00	0.00			
H (7)	0	0	0.00	0.00			
I (8)	0	0	0.00	0.00			
J (9)	0	0	0.00	0.00			
K (10)	0	0	0.00	0.00			

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Item D Item E Item G Item F Item H

IDCU# 1 PROT ISDN ANALOG PIDB

RT# TR IDENTIFIER DS1 LINE LINES LINES USERS NUTS

49 303 4 0 20 72 20 0

50 303 4 0 20 72 20 0

51 303 4 0 20 72 20 0

52 303 4 0 20 72 20 0

53 303 4 0 20 72 20 0

54 303 4 0 20 72 20 0

55 303 4 0 20 72 20 0

56 303 4 0 20 72 20 0

NRT PUB 2 0

PSU# 1 PROTOCOL HANDLER ASSIGNMENTS

DPIDB port - ism - trk/cnl spare total

sf a(0)__b(1)__c(2)__d(3)__e(4)__f(5) p2 p3 ts p2 p3 p2 p3 p2 p3 sum

4 0.00 0.00 0.00 0.00 0.00 0.00 0 0 0 0 0 0 0 0 0 0

3 0.00 0.00 0.00 0.00 0.00 0.00 0 0 0 0 0 0 0 0 0 0

2 0.00 0.00 0.00 0.00 0.00 0.00 0 0 0 0 0 0 0 0 0 0 Item P

1 0.00 0.00 0.00 0.00 0.00 0.00 0 0 0 0 0 0 0 0 0 0

0 1.00 1.00 1.00 1.00 0.00 0.00 0 0 0 0 0 0 1 0 5 5

5ESS Switch Engineering System

ISDN SM ASSIGNMENTS

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CLLI = grfngama22c TYPE = host CATEGORY = ISDN

ORDNO = 12345 STATE = sto XGEN = 9.10

Active PIDBs + DPIDBs for IDCU# 1 = 11

Total IDCU to TSIU PIDB Ports 6

Remaining TSIU Ports 23

ISLU PIDB TS 0 Reserved TS for NXDS0 0

IDCU PIDB TS 96 Spare TS for any unit --> 414

ISTF TS 0 PSU TS demand 0

DLTU TS 0 Available TS for PSU only 0

Inter-SM TS 0 IDCU Nail-up TS for TSIU 0

Packet Trunk TS for PSU 0 Used Nail-up TS for TSIU 0

Recovered DLTU TS (0) Avail Nail-up TS for TSIU 190

Sample DOPSMOD TR303 Capacity Report:

5ESS Switch Engineering System

CAPACITY REPORT

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CLLI = grfngama22c TYPE = host CATEGORY = idcu-1

ORDNO = 12345 STATE = sto XGEN = 9.10

DOPSMOD

SYMBOL	5 DOPS TITLE	QTY	DEMAND	CAPACITY	%UTL
IDCUHD	IDCU TCBH HD TO ABS RATIO	1.00			
IDCUBLK	PCT BLOCKING ON IDCU	1.50			
ABSCCS	WT AVG DS1 ABS NON-NU CCS/LINE	3.50			
HDCCS	WT AVG DS1 HD NON-NU CCS/LINE	3.50			
PTSLCR	IDCU CIRCUIT SWITCHED LCR	9.74			
CULINES	IDCU TR008 + TR303 LINES	736	Item 7		
CURTDS1	IDCU RT DS1 MINUS PROT LINES	32			
CUTSHR	IDCU RT TIME SLOT INFO HEADER	***			
DS1TSD	TR008 + TR303 DS1 TIME SLOT DE	204			
CSTSD	TR008/TR303 CKT SW AND ODB TS	92			
PPDNUTS	TR303 PPD TIME SLOTS	40			
PPBNUTS	TR303 PPB TIME SLOTS	8			
TSINUTS	TR008+TR303 TSI NON-SW SPC TS	0			
HPINUTS	IDCU HAIRPIN TIME SLOTS	32	Item 9		
MTCETS	TR003 EOC/TMC TIME SLOTS	32			
DS1TSC	TR008+TR303 DS1 TIME SLOT CAP	768			
DS1TSU	TR008+TR303 DS1 TIME SLOT UTL	27			
CUPUDS1	IDCU NRT DS1(S)	2	Item 8		
CUPUTS	NRT TSI NON-SWTCH SPECIAL TS	0	Item 10		
PITSDEM	IDCU PIDB TIME SLOT DEMAND	92			
PITSCAP	IDCU PIDB TIME SLOT CAPACITY	96			
PITSUTL	IDCU PIDB TIME SLOT UTL	96			
CUUSGHR	IDCU USAGE INFO HEADER	***			
CUCCSDE	IDCU PIDB WT. AVG. CCS/LINE DE	3.50			
CUCCSCA	IDCU PIDB CCS/LINE CAPACITY	5			
CUCCSUT	IDCU PIDB CCS/LINE UTL	70			

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 IDCUTD   IDCU PIDB LINE DEMAND                  736
 IDCUTC   IDCU PIDB LINE CAPACITY                768
 IDCUTU   IDCU LINE UTL                           96
 CUUSGTD  IDCU PIDB USAGE DEM - LINES            736
 CUUSGTC  IDCU PIDB USAGE CAP - LINES            889
 CUUSGCD  IDCU PIDB USAGE DEMAND - CCS          2576
 CUUSGCC  IDCU PIDB USAGE CAP - CCS             3111
 CUUSGU   IDCU USAGE UTL                          83
 IDCUMLU  IDCU MOST LIMIT - USG (ABS,HD)       abs
 IDCUML   IDCU MOST LIMIT - (USG, LINES)       lines
 IDCUMLC  IDCU ML CAPACITY IN LINES            768
CUDCHI    IDCU D-CHAN PKT INFO HEADER          ***
CUPKTLN   IDCU ISDN LINES                     160
CUDPPS    IDCU WT. AVG. D-CH DATA PPS/LN      2.00
DCHDPD    IDCU D-CHAN DPIDB(S)                3
DCHPDPB   IDCU D-CHAN PER DPIDB RATIO         80.00
 DPPSDEM  IDCU D-CHAN DPPS DEMAND               320
```

5ESS Switch Engineering System

CAPACITY REPORT

ISSUE: 16.00 VERSION: 2 DATE: 21FEB94 @ 13:18 CST

NPA = 303 LD = Base Load Division LOCATION = domestic

CLLI = grfngama22c TYPE = host CATEGORY = idcu-1

ORDNO = 12345 STATE = sto XGEN = 9.10

DOPSMOD

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SYMBOL	5 DOPS TITLE	QTY	DEMAND	CAPACITY	%UTL
DPPSCAP	IDCU D-CHAN DPPS PH CAPACITY			480	
DPPSUT	IDCU D-CHAN DPPS PH UTIL.			67	
CUPPBI	IDCU PPB PKT INFO HEADER	***			
IDCUPPB	IDCU PPB CHANNELS	8			
CUBPPS	IDCU WT. AVG. PPB DATA PPS/LN	20.00			
PPBDPD	IDCU PPB DPIDB(S)	1			
PPBPDPD	IDCU PPB PER DPIDB RATIO	8.00			
BPPSDEM	IDCU PPB DATA PPS DEMAND		160		
BPPSCAP	IDCU PPB DATA PPS PH CAPACITY			160	
BPPSUTL	IDCU PPB DATA PPS PH UTIL			100	
CUODBI	IDCU ODB USER INFO HEADER	***			
IDCUODB	IDCU ODB USERS	0			
CCSPODB	IDCU WT AVG CCS/ODB USR -DPIDB	0.00			
PPSPODB	IDCU WT AVG DATA PPS/ODB USER	0.00			
ODBDPD	IDCU ODB DPIDB(S)	0			
ODBDPDE	IDCU ODB CCS DPIDB DEMAND		0		
ODBDPCA	IDCU ODB CCS DPIDB CAPACITY			0	
ODBDPUT	IDCU ODB CCS DPIDB UTL			0	
AVGUSPH	IDCU ODB AVG USERS/PH - DEMAND		0		
ODBASPH	IDCU ODB USERS/PH - CAPACITY			0	
AVGUSUT	IDCU ODB AVG USERS/PH - UTL			0	

15.4.3 MEASUREMENTS AND PRIMARY SERVICE INDICATORS

Traffic measurement sections 139, 140, 141,142 ,and 143 are available in TRFC30.

- Attempts, blocked attempts, traffic usage, maintenance usage, and DS1 time slot quantities for each RDT

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- PIDB traffic for each IDCU
- DPIDB traffic for each IDCU
- Message traffic on the EOCs and TMCs for TR-303 RDTs in existing packet counts.

Traffic and hardware related events associated with IDCU are counted, as appropriate, in existing hourly, 24-hour, and monthly plant measurements. When a nailed-up or hair-pinned circuit is disconnected due to a failure, the existing count for nail-up failures (lost nail-up connections, part 1A of 24-hour plant report) are incremented.

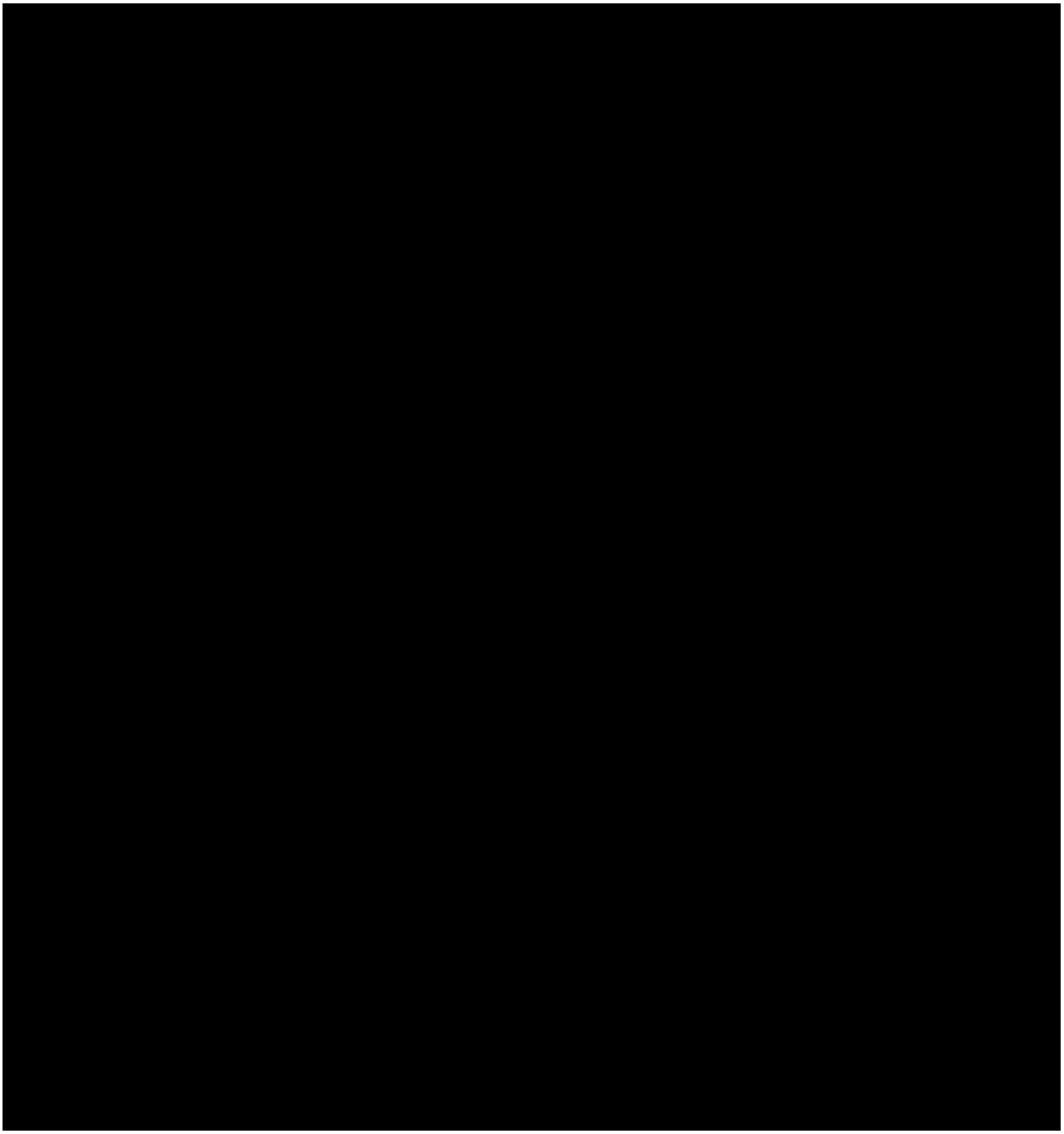

Figure 15.4-1 IDCU Block Diagram

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15.5 ISDN SOFTWARE UPDATES

15.5.1 ISDN FEATURE INFORMATION

ISDN related software changes are constantly evolving and changing with each new software release. Information regarding ISDN features such as feature descriptions, engineering considerations, retrofit and growth procedures, may be found in the *5ESS®* switch 235-100-125 *System Description*, feature manuals in the 235-190-XXX *Feature Description* series, and 235-105/106-XXX *Maintenance/Retrofit/Update/Growth Documents*. Features impacting switch administration, and engineering that is applicable to ISDN administration tasks are discussed in the appropriate sections of this document.

15.5.1.1 Measurements

Measurements on the TRFC30 Section 92 are provided for each X.75´ trunk group. The incrementing of counts in these measurements is a function of the activity on the individual trunk group. When alternate routing between trunk groups results in activity (attempts or calls) on more than one trunk group for the same call, the measurements are incremented for each trunk group independent of what might have been counted on other groups. This strategy is consistent with existing internal protocol (IP) trunk group alternate routing.

In addition, calls that transit from one X.75´ port to another X.75´ port in the same switch peg the "Tandem Calls" count on TRFC30 Section 69. (The tandem calls count on TRFC30 Section 69 now includes IP-IP, IP-X.75´, IP-X.75, X.75´-X.75´, X.75´-X.75, and X.75-X.75 tandem calls.)

15.5.2 Traffic Counts for Trunk Group Engineering

The IPC, OPC, and OFL in TRFC30 Section 12 are incremented once for each narrow band or wideband call. Trunk group counts are provided for incoming, outgoing, and overflow "total DS0s" (IPCTT, OPCTT, and OFLTT). These counts are pegged **N** times for the total trunks requested for all calls. Data generated by these counts support trunk group engineering. Counts of IPC and OPC can be compared with IPCTT and OPCTT respectively to determine the extent of wideband traffic on a trunk group.

Data reported in IPC and IPCTT provide a view of bulk arrival of incoming traffic on a trunk group during the period being studied. For OPC and OPCTT, the data provide a view of bulk use of facilities for outgoing calls on a trunk group. In the case of a PRI trunk group, OPC and OPCTT can also provide a view of the extent of wideband traffic to a particular customer during a period of interest.

The value of OFLTT compared to OFL can be used to determine patterns in overflow by traffic types. If OFL is low compared to OFLTT, wideband calls are overflowing the trunk group. This provides a view of quality of service provided for wideband calls. If the trunk group is PRI, the quality of service can be related to a particular customer. If the trunk group is ISUP7, overflow provides a measure of the extent that the trunk group is serving the network objectives for wideband connectivity.

Patterns on these counts during study intervals can be used in conjunction with random outputs from the OP:CHANMAP command to determine the DS0 vs. wideband traffic patterns on a trunk group. On narrow band trunk groups, the data generated by existing peg counts IPC, OPC, and OFL are the same as "total trunk" counts IPCTT, and OFLTT.

15.5.2.1 Engineering Considerations

Table 15.5-1 shows the maximum recommended NCT link occupancy levels for SMs supporting Fractional DS1/NxDS0 calls. Occupancy is controlled by leaving a certain number of time slots unused and is based on the bandwidth of the supported calls. The table shows the maximum recommended NCT link occupancy for 384, 768 and 1536 Kbps data rates.

For an existing SM, the number of unused time slots depends on the current vs. recommended NCT link

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occupancy for the bandwidth of the supported calls on the SM. Occupancy is provided in TRFC 30 Section 150.

NOTE: The SMs in Tables 15.5-1 and 15.5-2 also include RSMs and ORMs with TRCUs that are equipped with inter-SM trunking and 2-mile optically remoted modules.

Table 15.5-1 Maximum Recommended NCT Link Occupancies for NxDS0

	SM/SM-2000			ORM w/TRCU
	1536 Kbps	786 Kbps	384 Kbps	384 Kbps
PERCENT OCCUPANCY	73	78	79	75

The number of unused time slots needed can be achieved by deloading the SM. This can be accomplished by removing a Line Unit or a Trunk Unit from the SM. Removing either unit frees 64 unused time slots. A second alternative is to remove a DFI pack which frees 32 time slots. Table 15.5-2 shows an example of the number of unused time slots needed to achieve the acceptable NCT link occupancy level for 384 Kbps, 768 Kbps and 1536 Kbps calls on an SM and ORM.

Table 15.5-2 Unused Time Slots Based on Current NCT Occupancy

CURRENT OCCUPANCY	SM			ORM w/TRCU
	1536 Kbps	786 Kbps	384 Kbps	384 Kbps
72	0	0	0	0
73	0	0	0	0
74	32	0	0	0
75	32	0	0	0
76	32	0	0	32
77	32	0	0	32
78	32	0	0	32
79	32	32	0	32
80	64	32	0	32
81	64	32	32	32
82	64	32	32	64
83	64	32	32	64
84	64	32	32	64
85	64	64	32	64
86	96	64	32	64
87	96	64	64	64

If all wideband calls originate and terminate on the same SM-2000 (intra-SM calls), NCT2 link occupancy is within normal levels and it is not necessary to provide unused time slots. Note that this only apples to the SM-2000 case.

15.5.3 Redefine PH2 Access Image

To provide continued support for the Protocol Handler Model 2 Access Image (PH2A), this feature relieves potential PH2A memory exhaust in ISDN and OSPS applications. This feature also preserves the usefulness of the large embedded base of 1681PH2s. By removing packet data (X.25) capabilities from the PH2A, sufficient memory is recovered allowing existing and future voice and circuit switched data features to be provisioned on the lower cost PH2A.

As a result of the PH2 redefinition, only the four PH channels 0, 4, 8, or 12 can be assigned for Inter-Switch Module nail-up in the PH2. For limitations caused by this feature, refer to the 235-190-104, *Custom ISDN Features* document.

15.5.3.1 Engineering Consideration

To retrofit a *5ESS*® switch from 5E8 to a later softwarer release, all Integrated Services Digital Network (ISDN) lines using packet data features must be terminated on PH3s. or PH4s. This requires one of the following actions:

- Reassigning ISDN X.25 lines to existing PH3s or PH4s

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- Replacing PH2s with PH3s or PH4s
- Adding sufficient PH3s to handle the X.25 traffic then reassign ISDN X.25 lines to PH3s or PH4s
- Reassign all ISM channels to PH channels 0, 4, 8, or 12 only.

The amount of reassignment of lines to PH3s or PH4s depends upon the packet feature penetration and upon previous packet feature assignment philosophy used by the switch administrators.

15.5.4 Components of X.25 Data Transfer Delays

Data transfer delay is defined as the time between the entry of the last byte of a packet into the originating SM and the departure of the first byte of the packet from the terminating SM. Components of delay are shown in Figure 15.5-1 .

Figure 15.5-1 Components of Delay

Typical PH delays are approximately 10ms (PH2) and 5ms (PH3/PH4). Other components of delay should be negligible.

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16. PRIMARY SERVICE INDICATORS, CAPACITIES, AND THRESHOLDS

16.1 Overview

Primary service indicators are the key measurements that provide the Switch Administrator with a quick view of the overall system performance and quality of service being offered. These measurements are contained in the TRFC30 report that is transmitted to Data Collection Systems.

Thresholds can be set and automatically monitored so that an exception report is generated whenever any thresholds are exceeded to trigger further in-depth traffic studies or system adjustments. Proper use of thresholds can enable timely changes prior to experiencing any serious degradation of service. Recommended default thresholds are provided in this section, however local practices may determine that other thresholds should be used to allow for additional time to make any necessary adjustments.

> ***NOTE:*** Specified engineered capacities and recommended thresholds are High Day (HD) unless otherwise noted.

16.2 AM Performance

Indicator	TRFC30		Capacity	Threshold
	Section	Count		
CP Occupancy	15	PERCENT OCCUP	40%	32%
Total Load	15	LOAD	90%	80%

16.2.1 Call Processing Occupancy

The PERCENT OCCUPANCY count measures the percentage of AM processor real time consumed in performing only call processing functions. This traffic measurement only needs to be monitored for CNI offices without DLN. The AM Threshold of 32% is used to identify the need to begin the process of either obtaining a DLN or convert to PSU based SS7 signaling.

16.2.2 Total Load

The LOAD count measures the total AM processor occupancy including non-call processing activity. When the AM processor occupancy approaches capacity, the Operations, Administration, and Maintenance (OA&M) response times may be impacted. The 80% threshold is meant to be an average taken over all the busy hours (not the value for a single hour). Unlike AM call processing occupancy, the AM load value can fluctuate substantially throughout the day. Any office might see 80% or more for some particular hour of the day. Therefore, it is the average over the busy hours (typically between the hours of 8:00 AM and 5:00 PM) that will need to be monitored.

16.3 CM Performance

Indicator		TRFC30		Capacity	Threshold
		Section	Count		
CM2/ CM3	Blocking due to Overload	4	BLKOVD	□	> 0
	CMP Occupancy	126	PERCENT OCCUP	65% (local) 75% (tandem)	50% (local) 60% (tandem)
CM2 Only	MMP Cycles	18	BLCYC	No Load Count * 0.25	No Load Count * 0.3
	MSC Cycles	19	BLCYCL	No Load Count * 0.25	No Load Count * 0.6
	QGP Cycles	175	BLCYCL	No Load Count * 0.25	No Load Count * 0.3
	QGP-QLPS Pipe Occupancy	176	XMT RCV	70%	60%

16.3.1 Blocking Due to Overload

The BLKOVD count is incremented when it is determined by the SM that a route request message cannot

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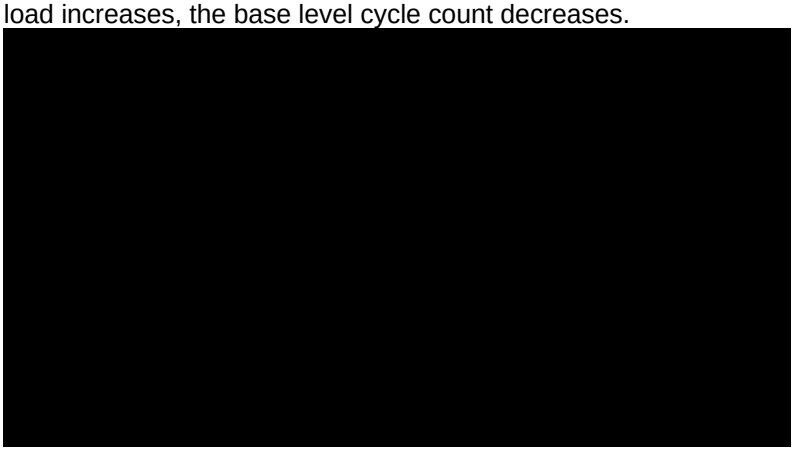
be sent to the CMP because of an overload condition, which results in the call being routed to reorder. This count should not normally exceed zero.

16.3.2 CMP Occupancy

When the CMP occupancy approaches capacity, longer post dialing call processing delays may be experienced.

16.3.3 MMP/MSC/QGP Cycles

Not all processors provide measurements in terms of occupancy due to the overhead required. The Base Level Cycle count provides a similar indication of the messaging load on the processor. As the messaging load increases, the base level cycle count decreases.



NOTE: The no load base level cycle count may vary based on office configuration and should be evaluated separately per office.

For the MMP and QGP, the recommended thresholds are set at 30% of the no load count.

For the MSC, the recommended threshold is set at 60% of the no load count since during normal operation the message load is shared by each side of the MSGS. This should allow sufficient spare capacity to meet the messaging needs even if the MSGS had to run in simplex mode.

16.3.4 QGP-QLPS Pipe Occupancy

The XMT and RCV counts measures the percent occupancies of the multi-timeslot pipe between the QGP and QLPS networks. TRFC30 Section 176 provides measurements for both average and 95th percentile occupancies. The 95th percentile measurement indicates the distribution of occupancies where 95% of all occupancies measured during the 30 minute period fall under. This can also be viewed as a peak occupancy. In most cases, the average occupancies should be sufficient to monitor as a primary indicator. However if an office has extremely peaked traffic characteristics, a peak occupancy of 90% capacity and 80% threshold may be used as an alternative indicator.

16.4 Network TSs

Indicator	TRFC30		Capacity	Threshold
	Section	Count		
NTS Mismatches	4	TSMM	□	> 0
	149/150	NTSMSM		
Peak NTS Occupancy	83/150	NTSOCC	90%	80%
Average NTS Occupancy	7/150	NTSUSG	75%	60%

16.4.1 Network TS Mismatches

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The Network TS Mismatch count is incremented when any originating call fails because the same numbered NCT Link TS on both the originating and terminating SM could not be matched.

- This counter scores for both originating and terminating SMs (Section 4/150).
- This counter scores for only the failed originating calls in the appropriate originating/terminating SM pair (Section 149).

If this count is greater than zero, additional NCT2 links may need to be grown on the SM-2000s. Classic SMs may need to be deloaded.

16.4.2 Network TS Occupancy

The "NTSOCC" count measures the peak occupancy observed in the 100-second scans of the network side time slots during the 30 minute period. The probability of TS mismatches increases as occupancy approaches 90%. If "NTSOCC" is consistently over 80%, growing in another pair of NCT2 links to the SM-2000 may be necessary. Classic SMs may need to be deloaded.

An alternative to using the peak occupancy is to calculate the average occupancy using NTSUSG, which measures usage in CCS and the number of Network TSs as follows:
Ave_NTS_Occupancy = [NTSUSG / (NTSs*18)] * 100

16.5 SM/SM-2000 Performance

Indicator		TRFC30		Capacity	Threshold
		Section	Count		
SM/ SM2K	SMP Occupancy	15	PERCENT OCCUP	90%	70%
	CTS Occupancy	125	Average RCV/XMT	75%	55% (RCV) 45% (XMT)
			Peak RCV/XMT	90%	75% (RCV) 65% (XMT)
SM2K Only	MH Cycles	185	CYCLES	No Load Count * 0.25	No Load Count * 0.3
	MH-QLPS Pipe Occupancy	177	XMT	70%	60%
			RCV		

16.5.1 SM Processor Occupancy

As the SM processor occupancy approaches capacity, longer dial tone delays may be experienced.

16.5.2 Control Time Slot Occupancy

The CTS occupancy measurements provide the average and peak occupancies for both receive and transmit directions. This measurement is not needed for an office with all SM-2000s and QLPS.

16.5.3 MH Cycles

Similar to the MMP, MSC, and QGP, base level cycle counts are used to indicate messaging load on the MH processor. If the threshold on MH0 is consistently exceeded, it may be necessary to deload the SM-2000. If the MH is used for peripheral units such as the DNU-S or EAIU, then it may be necessary to redistribute the peripherals.

16.5.4 MH-QLPS Pipe Occupancy

The SM-2000 uses the first Message Handler, MH0, to send and receive messages via a multi-timeslot pipe to the QLPS. TRFC30 Section 177 provides measurements for both average and 95th percentile occupancies. In most cases, the average occupancies should be sufficient to monitor as a primary indicator. However if an office has extremely peaked traffic characteristics, a peak occupancy of 90%

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capacity and 80% threshold may be used as an alternative indicator.

16.6 RSM/MMRSM

Indicator	TRFC30		Capacity	Threshold
	Section	Count		
Stand Alone Time	22	SATIME	□	> 0
Umbilical TS Blocking	23	UMOFL	0.05% (EVE)	> Engineered capacities on a consistent basis.
		UMPC	0.1% (HD)	
ICL TS Blocking	37	T1OFL	2% (EVE)	
		T1PC	4% (HD)	

16.6.1 Stand Alone Time

The SATIME count measures the number of seconds the RSM was in stand-alone and unable to communicate with the Host SM.

16.6.2 Umbilical Time Slot Blocking Calculation

The percent blocking for the Umbilicals is calculated as follows:
Umbilical_TS_Blocking = (UMOFL / UMPC) * 100

If the percent blocking is consistently greater than the engineered capacities, additional Umbilicals should be added, or the RSMs may need to be deloaded.

16.6.3 ICL Time Slot Blocking Calculation

The percent blocking for the Inter-Cluster Links is calculated as follows:
ICL_TS_Blocking = (T1OFL / T1PC) * 100

If the percent blocking is consistently greater than the engineered capacities, additional ICLs should be added, or the RSMs may need to be deloaded.

16.7 Line Blocking

Unit	TRFC30		Capacity	Threshold
	Section	Count		
AIU	216	TMBLK	1.5% (ABS)	> Engineered capacities on a consistent basis.
		TMATT	4% (EVE)	
DCLU RT	21	TERMBLK	7% (HD)	
		TERMATT		
DNU-S RT	224/225	TERMBLKD		
		TMATT		
IDCU RT	139	TMBLK		
		TMATT		
ISLU	49	TMBLK		
		TMATT		
LU	11	TMBLK		
		TMCALLS		

16.7.1 Terminating Blocking Calculation

Terminating calls are given priority over originating calls because terminating calls, which are nearly completed, have used more resources than originating calls. The percentage of terminating blocking is calculated as follows:
Terminating_Blocking = (TMBLK / TMATT) * 100

If the percent blocking is consistently greater than the engineered capacities, resources such as PIDBs should be added, or the unit may need to be deloaded.

16.8 Trunk Overflow

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Indicator	TRFC30		Capacity	Threshold
	Section	Count		
Trunk Group	12/212	OFLTT	□	Customer Defined
		IPCTT/OPCTT		
Packet Group	211	IFAIL/OFAIL		
		IATT/OATT		

16.8.1 Trunk Group/Packet Group Overflow

These Overflow indicators are based on the count of trunk calls that fail to complete in a given trunk or packet group due to an insufficient number of trunks or trunks that are out of service for maintenance.

NOTE: Network controls can also impact on trunk overflows. Information on the amount of network controls in place for an office should be known.

Trunks that overflow can increase the CMP load. Not only does the switch have to look for an alternate trunk group, but if the overflowed trunk group is a final route it may also cause an increased number of reorders or announcements. Trunk groups that overflow consistently should be evaluated more closely for proper size or maintenance usage

The percent of trunk overflow is calculated as follows:
TG_Overflow = [OFLTT / (IPCTT+OPCTT)] * 100
PG_Overflow = [(IFAIL+OFAIL) / (IATT+OATT)] * 100

The thresholds are customer defined using trunk service principles based on the type of trunk group engineered, such as high usage or final trunk group.

16.9 Service Circuits

Indicator	TRFC30		Capacity	Threshold
	Section	Count		
Dial Tone Delay	4	DTDPC/DTDSC	□	1.5% (ABS)
Tone Decoder Delay	4	TDAD/TDASC	□	1.5% (ABS)
Tone Decoder Blocking	7	OVFLOW	1% (ABS)	> Engineered capacities on a consistent basis.
		PEGCT	3% (EVE)	
			5% (HD)	
Transceiver Blocking	25	OVFLO/	1% (ABS)	
		PEGCNT	3% (EVE)	
	60	OVFL/PC	5% (HD)	
		VBOVFL/VBPC		
Conference Circuit	10	CCOFL	0.1% (ABS)	
Blocking		CCPC	5% (EVE)	
HLSC	8	SHTOVF/	5% (EVE)	
Blocking		RNGOVF	10% (HD)	
		PEGCT		
RAF/SAS Blocking	46	OVFL	1% (ABS)	
		ACCESS		

16.9.1 Dial Tone Delay

Dial Tone Delay Peg Count (DTDPC) indicates the ability to provide dial tone to non-ISDN customers within 3 seconds during the measuring interval. It is the key measurement for evaluating the capability of providing originating customer service.

Some factors that can cause excessive dial tone delay are:

- □ Line Peripheral Blocking

- □ HLSC Blocking

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- TD Blocking

- High SMP Occupancy

The percent of Dial Tone Delay is calculated as follows:
Percent_DTD = (DTDPC / DTDSC) * 100

16.9.2 Tone Decoder Delay

The Tone Decoder Attachment Delay counts the number of times during the measuring interval that the delay exceeded 3 seconds. The Tone Decoders are used to perform dial pulse and touch-tone digit collection for lines. Tone Decoders also perform multifrequency and dial pulse (except bylink) digit collection from trunks.

The percent of Tone Decoder Delay is calculated as follows:
Percent_TDD = (TDAD / TDASC) * 100

16.9.3 Tone Decoder Blocking Calculation

Tone Decoder blocking is calculated as follows:
TD_Blocking = (OVFLOW / PEGCT) * 100

If the percent blocking is consistently greater than the engineered capacities, additional Tone Decoders should be added.

16.9.4 Tone Transceiver Blocking Calculations

Tone Transceivers are used to:

(1) Receive/Outpulse Revertive Pulse signals, which is a method of interoffice signaling that originated with early Crossbar switches, which have almost all been replaced. This measurement does not need to be monitored unless a *5ESS*® is still connected to offices where Revertive Pulsing is still used for incoming and outgoing calls. Revertive Pulse Transceiver blocking is calculated as follows:
RP_Transceiver_Blocking = (OVFLOW / PEGCNT) * 100

(2) Receive/Transmit Multi-Frequency tones used with Channel Associated Signaling (CAS) trunks and support tone generation for Voice Path Assurance (VPA), which ensures the integrity of the voice path of sampled SS7 trunks (sampling rate defined per trunk group, typically 1/8).
LDSF_VPA_Blocking = (OVFL / PC) * 100

(3) Provide certain Voice Band Services (VBS) such as Incoming Caller Line ID (ICLID), Calling Name (CNAM), and Visual Message Waiting Indication (VMWI).
LDSF_VBS_Transceiver_Blocking = (VBOVFL / VBPC) * 100

If the percent blocking is consistently greater than the engineered capacities, additional Tone Transceivers should be added.

NOTE: For the LDSU used on Classic SMs, a common pool of tone transceivers support both Voice Path Assurance (VPA) and Voice Band Services (VBS) functions. Therefore LDSU Tranceiver blocking is calculated as follows:
LDSU_VPA+VBS_Blocking = (OVFL / PC) * 100

16.9.5 Conference Circuit Blocking Calculation

Conference Circuit blocking is calculated as follows:

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CC_Blocking = (CCOFL / CCPC) * 100

If the percent blocking is consistently greater than the engineered capacities, additional Conference Circuits should be added.

16.9.6 HLSC Blocking Calculation

The HLSC is used in the LU to support:

(1) Ringing functions for LU lines, where the ringing job is attempted again after a delay of a few hundred milliseconds. Ringing overflows should be extremely rare.

(2) Short jobs, which are those line tests performed by the HLSC at origination, termination, and disconnect.

NOTE: Some short job overflows are not service affecting. In particular, the disconnect short job performs only a line restore/verify function and can be skipped during periods of high HLSC demand without affecting service. For an originating call, the originating short job is queued until a HLSC is available. PEGCT and SHTOVF counters score each 1/10 second that the short job is queued, which can potentially distort the blocking calculation.

HLSC blocking is calculated as follows:
HLSC_Blocking = [(RNGOVF+SHTOVF) / PEGCT] * 100

16.9.7 RAF/SAS Blocking Calculation

RAF and SAS Announcement blocking is calculated as follows:
RAF/SAS_Blocking = (OVFL / ACCESS) * 100

If the percent blocking is consistently greater than the engineered capacities, additional RAF/SAS circuits should be added.

NOTE: For Business and Residential Customer Services (BRCS) announcements, the ACCESS count measures successfully terminated (seizures) rather than total attempts, therefore the calculation for RAF/SAS blocking for BRCS announcements is as follows:
RAF/SAS_Blocking(BRCS) = [OVFL / (ACCESS+OVFL)] * 100

16.10 Signaling Platform (CNI)

Indicator	Measurement		Capacity	Threshold
	Report	Count		
DLN/DLN30 Occupancy	TRFC30 Section 66	AP	80%	70%
		APMAX	90%	80%
Link Pair Occupancy	SMR-A15MPR15	BYTES_IN	40%	> Engineered capacities on a consistent basis.
		BYTES_OUT		

16.10.1 DLN Occupancy

The AP count measures the average occupancy of the DLN AP processor, and the APMAX count measures the peak occupancy measured during the 30 minute interval.

16.10.2 Link Pair Occupancy Calculations

Transmit_bps = BYTES_OUT * 8bits / 900sec.
Transmit_occupancy = (Transmit_bps / 56,000bps) * 100
Receive_bps = BYTES_IN * 8bits / 900sec.
Receive_occupancy = (Receive_bps / 56,000bps) * 100

The total bytes transmitted and received for each signaling link terminated on the CNI is listed on the

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16.11 Signaling Platform (PSU)

Indicator	TRFC30		Capacity	Threshold
	Section	Count		
On Demand B Blocking	221	OVFL / TOTAL ATMPT	1.5% (ABS) 4% (EVE) 7% (HD)	> Engineered capacities on a consistent basis.
PH Occupancy	52	OCCUP	70%	55%
PH Overload	52	OVLD	□	> 0
PI Occupancy	51	OCCUP	70%	60%
PI Overload	51	OVLD	□	> 0
QPH-QLPS PIPE Occupancy	183/ 193	XMTOCC RCVOCC	70%	60%
Signaling Link Occupancy	230	NSFX/ ORTR/ NSFR / MSUX/ MRTR/ MSUR	40%	> Engineered capacities on a consistent basis.
Setup Delay	53	SETUP_DELAY	□	> 0
Packet Calls Blocked due to Overload	69	OVLDEN	□	1.5% (ABS)
Packet Call LCCB Overflow	68	LCCB OVFL	□	> 0

16.11.1 On Demand B Blocking Calculation

ODB blocking is calculated as follows:
ODB_Blocking = (OVFL / TOTAL ATMPT) * 100

If the percent blocking is consistently greater than the engineered capacities, PSU resources should be checked.

16.11.2 Protocol Handler (PH) Occupancy/Overload

The OCCUP count measures the PH processor occupancy based on the application type. PH occupancy is not expected to be a concern for basic DSL circuit-switched service. For ISDN packet services or SS7 applications, OCCUP may be monitored to determine if load balancing is necessary.

The time in overload (OVLD) count can be used as a trigger to prompt a closer examination of the PH occupancy or other PH measurements.

16.11.3 Packet Interface (PI) Occupancy/Overload

The PI occupancy is not normally expected to have capacity concerns, however the OVLD count can be used as a trigger to monitor other TRFC30 Section 51 measurements more closely.

16.11.4 QPH-QLPS PIPE Occupancy

TRFC30 Section 183/193 provides measurements for both average and 95th percentile occupancies for the multi-TS pipe between the QPH/GQPH and the QLPS. In most cases, the average occupancies should be sufficient to monitor as a primary indicator. If an office has extremely peaked traffic characteristics, a peak occupancy of 90% capacity and 80% threshold may be used as an alternative.

16.11.5 Signaling Link Occupancy Calculations

The SS7 Signaling Link Occupancy is calculated as follows:

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Transmit_bytes = (NSFX+ORTR) + [6*(MSUX+MRTR)]
Transmit_bps = Transmit_bytes * 8bits / 1,800sec.
Transmit_occupancy = [Transmit_bps / (56,000bps or 64,000bps)] * 100
Receive_bytes = NSFR + 6*(MSUR)
Receive_bps = Receive_bytes * 8bits / 1,800sec.
Receive_occupancy = [Receive_bps / (56,000bps or 64,000bps)] * 100

The NSFX (data bytes transmitted), ORTR (data bytes retransmitted), and NSFR (data bytes received) counts do not include 6 bytes that are added to each SS7 Message Signaling Unit (MSU) for header and flag information. These bytes are accounted for by multiplying 6 overhead bytes by the MSU transmitted (MSUX), retransmitted (MRTR), and received (MSUR) counts. The total bytes measured during the 30 minute period is then converted to bits per second and divided by the capacity of the signaling link.

16.11.6 Setup Delay

The SETUP_DELAY count is the number of circuit-switched ISDN calls that had setup message delays exceeding 3 seconds. This count is similar to Dial Tone Delay used for non-ISDN calls as a measure of the quality of providing originating service. If the PH is in overload, longer setup delays may be experienced.

16.11.7 Packet Calls Blocked due to Overload

The OVLDEN measurement represents the total number of X.25 originating calls plus internal protocol (IP) incoming calls denied due to PH (originating access, inter-SM, interswitch, or terminating access), PI, or SMP overload.

16.11.8 Packet Call LLCB Overflow

The Logical Channel Control Block Overflow (LCCB OVFL) count measures the number of unsuccessful attempts to seize a LCCB, which is a software data area on the PH that tracks per-call dynamic data such as logical channel number, call states, routing information, and billing data.

16.12 Miscellaneous Office Indicators

Indicator	TRFC30		Capacity	Threshold
	Section	Count		
Matching Loss	5	MACHLOS	□	Customer Defined Based on Averages
No Circuit	5	NOCKT	□	
Reorder	4	REORD	□	
ASP Failures	231/232	FAIL-CP	□	> 0
NS Failures	91	FAIL-CP	□	> 0

16.12.1 Matching Loss

Matching loss refers to calls that fail because of unavailability of a network/peripheral path to an idle line or trunk. Losses due to any resource failure such as the high-level service circuit (HLSC) are excluded from this count.

Matching loss is measured on the following call types:

- □ Originating
- □ Incoming
- □ Incoming First Failure to Match
- □ Intra-Office
- □ Outgoing

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- Terminating
- Tandem.

The MACHLOS indicator cannot point directly to a problem, but it does provide an indication that a problem exists. Other indicators (such as usage and overflow counts collected for the associated resources reported in the TRFC30 sections) can then be observed to determine the cause of the problem. In particular, TS Mismatch and Line Peripheral blocking should be investigated.

16.12.2 No Circuit/Reorder

The NOCKT count represents the number of calls lost due to a resource shortage, which includes:

- High Level Service Circuit (ring overflow and short job overflow)
- Tone Decoder
- Universal Conference Circuit
- RP/Tone Transceivers
- Final Outgoing Trunk Group Overflow

> ***NOTE:*** Option ID 983, "Inhibit No Circuit Peg Counts on Final Route Type of Busy", has an impact on the NOCKT count. Any final TG routed to busy will not score NC when this option is active.

The REORD count represents the number of calls sent to reorder tone. This count is similar to NOCKT in that it represents lost calls due to unavailable resources, however REORD also includes additional conditions such as customer dialing irregularities, abandons, and translations errors.

While neither the NOCKT or REORD counts isolates the trouble, it does indicate when overflow and usage counts for other resources should be observed more closely.

The table below provides a summary of measurements scoring REORDER, NO CIRCUIT, BOTH, or NONE.

TRFC30		Measurement	Reorder	No Circuit
Section	Count			
3	CDIRR	Customer Dialling Irregularities	Yes, if routed to Reorder No, if routed to Announcement	No
4	BLKOVD	Calls Blocked due to Overload	Yes	No
	TSMM	Time Slot Mismatches	Yes	No
	REORD	Bad message received during call set-up invalid data-static or dynamic has been encountered	Yes, if routed to Reorder No, if routed to Announcement	No
		Translation Errors in Digit Translations if LDITS and PDITS don't have proper routing	Yes	No
		Generic Code Problems in Call Processing	Yes	No
		Call Pickup on a Line not in their Group	Yes	No
		Call Pickup sends reorder to the second Line that tries to Pickup	Yes	No
		Station Restrictions	Yes	No
		The failure to the forward to party	Yes	No
5	NOCKT	Originating Calls Incoming Calls	Yes, if routed to Reorder	Yes

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		IntraOffice Calls Outgoing Calls Terminating Calls Tandem Calls	No, if routed to Announcement	
6	PERMSIG PDTIMO	Ineffective Attempts Permanent Signal Partial Dial Time-Outs	Yes, if routed to Reorder No, if routed to Announcement	No
7	OVFLOW	Tone decoders not available	Yes	Yes
8	SHTOVF	High Level Service Circuit Short Jobs Overflows	No	Yes
	RNGOVF	High Level Service Circuit Ringing Overflows	Yes	Yes
10	CCOFL	3 & 6 Port Conference Circuits not available	Yes	Yes
11	TMBLK	Line Unit - Termination A-B Links unsuccessful	Yes	No
12	TGOFL	Final Route - Trunk Groups not available Includes DID, PRI,Trunk Group, Announcements,SAS and RAF overflows	Yes	Yes
15	PUQCO	Pickup Queue Call Overflows - No time slots available in Pickup Grp	Yes	No
17	HPCNC HPCIXCNC	GETS - Outgoing High Probability (HPC) of Completion Calls & IXC Calls to No Circuit	Yes, if routed to Reorder No, if routed to Announcement	Yes
	HPCTGQOF HPCTGQTMO	GETS - HPC Trunk Group Queue Overflows Queue Time-out	Yes, if routed to Reorder No, if routed to Announcement	No
	HPCACBLK	GETS - Automatic Call Gap (ACG) blocked HPC call attempts	Yes, if routed to Reorder No, if routed to Announcement	No
20	TRMBLK	Call blocked at the Remote Terminal terminating on a DCLU	Yes	No
21	TERMBLK	Call blocked at the DCLU	Yes	No
26	DIRG	Activating or Accessing Features not available on a line	Yes	No
	APBO ACBCO CLDBO MDBO	Overflow feature data structure exhausted (blocks not available)	Yes	No
	SFGQREO	SFG Reorder or Queue Overflow- OUTWATS	Yes	No
	TGQREO	Trunk Group Reorder or Queue Overflow - Automatic Route Selection or Private Facilities	Yes	No
31	DPAT	Wrong IDP DPAT category	Yes, if routed to Reorder No, if routed to announcement or call re-routed to another number	No
32	SOVFLPOVFL	SFG overflow	Yes	No
33	OVFL	Attendant Group Overflow	Yes	No
34	OVFL	MLHG Overflows	Yes	No
35	INSF_FRL	Automatic Route Selection Insufficient Facility Restriction Level	Yes	No
36	REORD	Direct Signaling Failure	Yes	No
37	T1OFL	ICL Links Overflow (and no Umbilical TS available)	Yes	No
40	OVFL	MLHG Queue	Yes, if routed to Reorder No, if routed to	No

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			Announcement	
44	REORDER	OSPS Calls Sent to Reorder	Yes	No
	FAILURE	OSPS Can Not Be Reached Due to Failures	Yes	No
46	OVFL	Announcement Services Overflow	No	Yes
49	TMBLK	ISLU Terminating Circuit Call Blocked - no idle time slot	Yes	No
50	ISOPDTO ISOPS	ISDN Permanent Signals And Partial Dial Time Outs	Yes, if routed to Reorder No, if routed to Announcement	No
55	ROVFL RTIMOUT	Queuing for Private FacilityTrunk Groups	Yes, if routed to Reorder No, if routed to Announcement	No
57	POVFL PTIMOUT	Queuing for SFGs for Private	Yes, if routed to Reorder No, if routed to Announcement	No
60	OVFL	LDSU Tone Transceiver Overflow LDSF VPA Tranceiver Overflow	No	Yes
	VBOVFL	LSDF VBS Transceiver Overflow	No	Yes
61	3PORT 6PORT	OSPS - 3 or 6 Port Conference Circuit Request Not Served	Yes	Yes
76	OVFL(Auto Callbk) OVFL(Auto Recall)	Unsuccessful Automatic CallBack or Automatic Recall Access Attempt	Yes, if routed to Reorder No, if routed to Announcement	No
77	TERM BLKD	ISLU terminating path blocked	Yes	No
90	BLOCK	Line Counts Blocked Terminating Calls	Yes	No
93	OVFL	Remote Access Denied Due to Overflow	Yes	No
100	NPROV	OSPS T&A Coin Calls - No Notify Announcement Due to lack of resources	Yes	Yes
102	REORD	OSPS ACCS calls reordered due to TCS restrictions	Yes	No
103	OVFL	OSPS DSU-2/LDSUF CAMA Tone Decoder Overflows	No	Yes
107	TERM BLKD	ISLU Terminating Path Not Available	Yes	No
120	NOCKT	ISUP failures	Yes	Yes
139	TMBLK	IDCU - Attempt to Terminate a CSD Call was blocked, no PIDB time slot available	Yes	No
141	TOTAL OVFL	IDCU Overflow	Yes	No
143	TERM BLKD	IDCU Call was Blocked due to No DS1 Time Slot Available	Yes	No
144	OTBLK	Line Unit Calls Blocked due to No Idle A/B Links	Yes	No
182	REORD	ACD/BRCS Calls Routed to Reorder	Yes	No
216	RGOVL	Ring Generator Overloaded for AIU	No	Yes
	TMBLK	AIU - Terminating Blockage due to No PIDB Time Slot Available	Yes	No
224	TERM BLKD	DNU-S Lines Blocked per Switching Module (SM)	Yes	No
225	TERM BLKD	DNU-S Lines Blocked per Remote Terminal (RT)	Yes	No
233	GTTF	SCCP Translation Failures	Yes	No

16.12.3 ASP Failures

Several Advanced Services Platform (ASP) measurements are available to determine why the failure occurred. In the case of the "CALL PROCESSING FAILURE" counts being greater than zero, the problem can be isolated to translation errors, resources unavailable, or maintenance issues. Resource unavailability or maintenance problems can be singled out if the "RESOURCE UNAVAILABILITY" counts also peg. Translation errors or maintenance problems can be isolated if the "MESSAGE ERROR" counts are pegged.

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16.12.4 NS Failures

The Number Services (NS) capability enables a *5ESS*® equal access end office or access tandem office to interface with telephone company data bases, using Signaling System 7 and transaction capabilities protocols. The 800 service is an example of a Number Service.

GLOSSARY

The following abbreviations, acronyms and terms are used in these guidelines:

-- Glossary --

2-Mile Optically Remoted Module (TRM)
An SM located up to 2 miles from the CM and connected by a multimode optical fiber that serves as an extended NCT link.

A-Link
The A-link connects the first- and second-stage switches of the line unit.

ABBH (Average Bouncing Busy Hour)
The ABBH load value is the BBH load averaged across the BS. The ABBH is also referred to as the mean daily peak (MDP).

ABS (Average Busy Season)
The three months with the highest average traffic in the busy hour.

ABSBH (Average Busy Season Busy Hour)

ABSBHL (Average Busy Season Busy Hour Load)
The average of the TCBH traffic loads for 3 months, not necessarily consecutive, that have the highest average traffic. The busy season data excludes extremely high traffic days that can be attributed to unusual events. It may also exclude weekends if the traffic is low during these days.

ACB (Automatic Callback)
This feature allows the subscriber, after reaching a busy station, to hang up the telephone and dial the activation code and the busy station directory number to activate automatic callback. When the busy station goes on-hook and the calling station is on-hook, the calling station will receive a distinctive ringing pattern. When answered, a call will automatically be completed to the previously busy station.

ACBC (Automatic Callback Calling)

ACCED (Access Editor)
An administrative memory module function that controls the freeing and use of terminating number assignments.

ACD (Automatic Call Distribution)
A feature that automatically distributes calls to attendant or agent positions according to the call parameters (for example, to an agent who has been idle for the longest period).

ACD/BRCS (Automatic Call Distribution/Business and Residence Custom Services)
Enables ACD agents to operate in a centrex environment, to have access to BRCS features, and to be in the same business group as non-ACD users.

ACSR (Automatic Customer Station Rearrangement)
An ISDN feature permitting the end-user to relocate their terminal equipment and associated directory number.

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ACT (Alternative Code Treatment)
A capability that allows customers to give alternative treatments to specified IDP codes at certain times. This is done by associating a valid ID code with an alternative code treatment set (ACT set). The ACT set is associated with an on/off indicator and alternative treatment instructions. When the indicator is off, normal treatment is given when a line dials a code in the ACT set. When the indicator is on, alternative treatment is given when a line dials a code in the ACT set.

ADP (Average Daily Peak)
A statistical variable value used in the EVE methodology. The ADP is the average of the highest loads, each day, averaged over a typical period of 20 days.

AIS (Automatic Intercept System)
An OA&M feature permitting calls from Class 5 offices to nonworking telephone numbers or to calls to telephone numbers placed on trouble intercept to be connected to announcements or to operators.

AIU (Analog Interface Unit)
The AIUs are hardware such as the LUs and TUs that interface wires from the MDF to peripheral interface control, and data buses to the module processor and TSI.

ALIT (Automatic Line Insulation Test)
An OA&M feature enabling routine testing of analog line appearances that terminate directly on the switch. Tip-to-ring, tip-to-ground, and ring-to-ground leakage tests are performed.

AM (Administrative Module)
The part of the *5ESS*® switch which performs call processing, administration, and maintenance which cannot be economically distributed to the switching modules. The AM consists of the processor, disk storage, and tape backup units. The AM processor performs the centralized processing functions, controls the high-speed tape, and the flow of data between the other dedicated processors distributed throughout the remaining units. The processor functions are fully duplicated (except for the port switch) in order to assure continued processing capability.

AMA (Automatic Message Accounting)
The automatic accumulation of call data such as calling number, called number, date, time, duration, etc., which will subsequently be processed by the RAO to render a customer's telephone bill. Magnetic tapes and disks are used to store the information pertinent to local and toll calls for billing purposes.

AMAT (AMA Teleprocessing)

AMATPS (Automatic Message Accounting Teleprocessing System)
A billing system feature where the *5ESS*® switch forwards billing information over a data link to a centralized AMA data collection system. The AMA data collection system interfaces with an RAO.

ANI (Automatic Number Identification)
A feature of a local switching office that automatically identifies the calling party without operator intervention.

AOC (Announce Only Channel

AP (Attached Processor)

APR (Automatic Power Recovery)
Automatically restores powers up SM to at least simplex state after a system-wide power outage.

AR (Automatic Recall)

ARS (Automatic Route Selection)
This feature directs outgoing, business customer calls to the customer's most preferred available

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route. The customer may preselect a sequence of up to four private routes for each code point in the DDD network for which a charge applies.

ASCII (American Standard Code for Information Interchange)

ASP (Auxiliary Services Position)

ASP (Advanced Services Platform)

AT (Access Tandem)

An *ESS*™ switch used to provide carrier access to end offices and possibly to co-located stations by the station user to directly control, in stages, the routing of an outgoing tie trunk call through the originating, as well as any intermediate switches. The user is said to "cut-through" these offices. These trunks are referred to as "nonsenderized" or "tandem" tie trunks.

AUTOVON (Automatic Voice Network)

A private 4-wire telecommunication network used by authorized agencies of the government. This network provides its subscribers with services similar to the public network plus unique features specific to the government applications. The terms AUTOVON, DSN, and DSN/AUTOVON are used interchangeably when referring to this network.

AVRT (Avoidance Routing)

Administration

Administration is a number of related functions with the objective of ensuring the overall provision of service by the *5ESS*® switch. Administration includes the assignment of lines and trunks to the system, memory management, collection of traffic and plant data, provisions for additions and modifications to the switch, service evaluation, and capabilities to control and manage the *5ESS*® switch. The primary objective of administration is to assure that the *5ESS*® switch delivers a high level of quality service to the subscribing customers. This is accomplished by monitoring and evaluating system performance. Potential problems that could cause service deterioration are identified.

Attempt

This is a peg count of an effort to use a facility or a circuit. An attempt may be a success or a failure.

Attribute

This is a column in a data table having unique names.

B-Link

The B-links are the outputs from 16 line unit (LU) half-grids that are multipled onto 64 different paths.

BBH (Bouncing Busy Hour)

The BBH is the candidate busy hour (CBH) in which the daily peak (DP) load occurs.

BFG (BRCS Feature Grouping)

The BFG function provides group feature assignment to lines. A BFG is a group of features and parameters. A BFG is not a group of DNs, terminals or MLHG members, but a BFG may be assigned to any number of DNs, terminals or MLHG members.

BH (Busy Hour)

The hour among the CBHs having the highest average traffic load during the BS (busy season).

BIC (Bus Interface Controller)

A unit which interconnects a duplex bus selector to the microprogrammer controller of the PIC.

BLKOVD (AM/CMP overload)

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BLL (Base Level Loop)
The software loop where the routine functions of the system are performed.

BORSCHT
Battery feed, overvoltage protection, ringing, supervision coding and decoding, hybrid (2-wire, 4-wire conversion) and testing. These functions are provided in the LU.

BPOQ (Base Priority Output Queue)

BRCS (Business and Residence Custom Services)
The *5ESS* ® switch software that makes revenue generating features available to both business and residential customers.

BRCSDB (BRCS Data Block)

BRI (Basic Rate Interface)
The customer interface to the ISLU that combines two B-channels and one D-channel.

BS (Busy Season)
Same as ABS

BSTR (Bootstrapper)
A part of the "fast pump" data link that interfaces with the processor update bus to gain access to SM processor memory. (Also see Bootstrap.)

BWM (Broadcast Warning Message)
Obsolete term. See Software Update.

BLL (Base Level Loop)
The software loop where the routine functions of the system are performed.

BRI (Basic Rate Interface)
The customer interface to the ISLU that combines two B-channels and one D-channel.

BIOQ (Base Input/Output Queue)

BSTR (Bootstrapper)
A part of the "fast pump" data link that interfaces with the processor update bus to gain access to SM processor memory. (Also see Bootstrap.)

BX.25
Lucent Technologies Bell Laboratories version of the Telecommunications Standardization Sector (ITU-T) protocol X.25. This protocol is used for exchanging messages between the MSGS and the SM.

Bootstrap
An initialization action which results in a memory reload and software initialization.

Bylink
This link is used when the distant central office originates a call on a trunk and the distant central office cannot hold the dialed digits until a signal processor is attached. If the digit receiver is not attached quickly, the first received digit may be mutilated. When dialed digits are recognized, they are counted and stored in temporary memory.

Byte
The number of bits (usually 8) in a binary word.

C&D (Control and Display)

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CAMA (Centralized Automatic Message Accounting)
This feature permits a *5ESS*® switch office to collect and store toll information and message unit billing on the CAMA calls originated by local offices served by the CAMA office.

CANF (Cancel □ From Control)

CAPFIT (Capacity Fit)

CBH (Candidate Busy Hours)
The hours that the daily peak load occurs. It is assumed that the CBHs in each day are fixed, and the number of CBHs is an office parameter.

CCBCOM (Channel Control Block Communication Region)

CCIS
See Common Channel Signaling.

CCITT (International Telegraph and Telephone Consultative Committee)
See ITU-T.

CCOFL (Conference Circuit Overflow)

CCS (Common Channel Signaling)
An operating capability of the *5ESS*® switch software release that is compatible with the CCIS6, ECIS6, DSIS6, CCS7 and ITU-T message protocols and permits the *5ESS*® switch to access the No. 2 STP network.

NOTE: CCS7 is now replaced with Signaling Switch 7 (SS7).

CCS (Hundred Call Seconds)
A unit of traffic. One user using one facility (for example, a trunk) for 1 hour generates 36 CCS (3600 seconds in 1 hour divided by 100).

CCS7 (Common Channel Signaling 7)

CCSA (Common Control Switching Arrangement)
The common control switching arrangement is groups of trunks and one or more switching machines used to switch calls in a private leased network. All stations connected in the private network may call one another without using the public toll facilities. In addition, CCSA provides access to DDD network for network inward calling to the centrex group, direct outward dialing to the DDD network, and other features to access the exchange network.

CDAR (Customer-Dialed Account Recording)
A BRCS feature enabling a business group customer to associate a personal account number with a call and have it recorded on the AMA record. The customer can use this record for allocating charges on both outgoing and incoming calls.

CDI (Control and Data Interface)
The circuit providing the TU service group interface through the PICB and PIDB to the MCTU.

CDO (Community Dial Office)
A small automatic central office, located and sized to serve a small community, usually unattended, and often having trunks to only one other office. Operator services are provided from a nearby attended office.

CDX *5ESS*® Switch (Compact Digital Exchange)

CF (Control Fanout)

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A pack that provides the distribution of control information to and from PHs.

CFNS (Call Forwarding Night Service)

CFPF (Call Forwarding Over Private Facilities)
A BRCS feature enabling a customer with private facilities such as foreign exchange lines, WATS, CCSA, etc., and has dial access or automatic route selection access to these facilities, to use the private facilities during the call forwarding activation process.

CFR (Centralized Flexible Rating)
An OSPS feature introduced with software release 5E4 providing the mechanism for issuing a rating query to and receiving a reply from, the Centralized Flexible Rating data base external to the OSPS on real-time rated calls.

CFV (Call Forwarding Variable)
A BRCS feature allowing a station user to redirect calls intended for that station to another telephone.

CG (Concentrator Group)
Synonymous with LU pair of concentrators. There may be 4, 6, 8, or 10 concentrators to an LU.

CGA (Carrier Group Alarm)
This feature allows the local switching system to infer the failure of a carrier group from observed call failures on only a few trunks in the trunk group.

CHDB (Channel Data Bank)

CI (Carrier Interconnect)
Provides an interface between the local exchange and the interexchange carrier.

CI (Control Interface)
A subunit of the TSIU, the control interface: provides the interface and monitors communications between SM processor and the interface units and reports errors detected; receives, latches, and reports service requests from interface units to the SM processor; and distributes control and clock signals to the module PUs by way of the peripheral interface control bus.

CIB (Control Interface Bus)
The bus carrying the control messages between the control fanout and the data fanout.

CID (Call Identifier)

CIP (Critical Indicator Panel)

CLDB (Calling Leg Data Block)

CLNK (Communication Link)

CM (Communication Module)
Hardware that provides the interface between the AM and the SM(s). In a multimodule office, the CM consists of the message switch and the TMS.

CM2 (Communications Module 2)
An updated version of the CM that is physically smaller but has an increased call handling capacity. This has been accomplished by use of the new operationally larger TMS2 and MSG2, now housed in the CM2 cabinet instead of separate TMS and MSGS cabinets.

CM2C (Compact CM2)

CMCU (Communications Module Control Unit)

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The CMCU, a part of CM2, provides message interface and timing facilities used to synchronize the time division network in the TMS by way of the TMSU. The CMCU consists of a DMI, NCLK2, TMS controller, and metallic interface. The CMCU is not used in the CM1 configuration (see MICU).

CMP (Communication Module Processor)
Introduced in 5E6, the CMP is a two board processor that increases the call processing and OA&M capacity of the switch by down-loading some of the former functions of the AM to the CM.

CN (Change Notice)

CNCC (Customer Network Control Center)

CNI (Common Network Interface)
The CNI functions as a packet switching system in the signaling network. The CNI is not a stand-alone switching system but requires configuration to an application such as the *5ESS*® switch. The CNI consists of several peripheral processors (RPCs and LNs) serially interconnected and a central processor that performs the basic operating system duties in a distributed I/O processing architecture.

CNI/IMS (Common Network Interface/Interprocess Message Switch)
The CNI/IMS consists of a single *5ESS*® switch cabinet that provides two types of ring nodes: RPCs and LNs. the CNI/IMS is connected to the AM by way of a dual serial channel and also interfaces with DDS facilities.

CO (Central Office)
The central office is the switching equipment in a building that provides exchange telephone service for a given location. In some cases, there is more than one central office serving the same area. A central office may include more than one central office code.

CODEC (Coder □ Decoder)

COER (Central Office Equipment Report)
This is a centrally located traffic data retention and reporting system. This is a Lucent Technologies OS that helps determine traffic load capacities.

CORC (Customer-Originated Recent Change)
A customer-originated data base change to initiate a change in characteristics (lines, trunks, equipment and/or features associated with the customer's telephone numbers).

COT (Central Office Terminal)
Hardware that changes electromechanical signals to analog signals.

CP (Central Processor)
The central processor provides the primary control for operating the equipment that directs calls through the central office and aids in detecting and analyzing any faulty equipment involved in this task. In the *5ESS*® switch, the AM is the central processor.

CPE (Customer Premises Equipment)
Telephone equipment located on the customer's premises.

CRA (Call Recorder Assembler)

CRO (Cancel Rerouted Overflow)

CS (Call Store)

CSR (Customer Station Rearrangement)
A BRCS feature that allows customers to make changes affecting their telephone service from an

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on-premises terminal, for example; to move or swap directory numbers, change or display features associated with their lines, and verify that the data assigned to their lines or features is correct.

CSS (Cyclic Sequential Search)
A path hunt used in the *5ESS*® switch call processing software.

CSU (Combined Services Unit)
A unit that combines the functions of a DLTU, MMSU, DSU-2-SAS, and GDSF in one shelf.

CTS (Control Time Slots)
The periods in time when control signals are transmitted during multiplexing or received during demultiplexing.

CTTU (Centralized Trunk Test Unit)
An OS providing centralized trunk maintenance through a data link. This allows the switching control center maintenance personnel to perform remote trunk testing from a work station on a local switching office. .GW"Call" A call consists of two half-calls. The count is represented by the sum of the originating peg count and the incoming peg count. .GW"Call Attempt" Call attempt is a line or trunk origination (off-hook) that is connected to a UTD or signal processor, plus at least one digit dialed before the line or trunk goes on-hook.

Call Gapping
A control which regulates the maximum rate at which calls are released towards a destination code.

Call Type
A 3-digit code generated by a class 5 office which identifies the type of call being originated.

Central Office Code
The central office code is a 3-digit code that designates a group of 10,000 consecutive telephone numbers. A switch may have more than one central office code. The central office code is the first three numbers or digits of the 7-digit customer number.

Circuit Pack
A circuit pack is a plug-in unit used as a convenient means for assembling, on a single mounting, one or more components such as capacitors, inductors, diodes, resistors, transistors, etc. The components are interconnected to perform one or more circuit functions, such as amplification, gating, timing, etc., required in a circuit.

Complaint Observing
Complaint observing is used when repeated trouble reports on a customer station indicate the need for further efforts to resolve the problem. All AMA calls are detailed billed (flagged) with a special mark.

Component
A server such as a trunk, tone decoder, or service circuit that is a shared resource as opposed to being dedicated.

Concentrator
A digital switching entity that permits more customers to share common output lines (for example, a 2:1 concentrator permits 48 customers to share the 24-channel capacity of a single T1 line)

Concentration Ratio
The ratio of the number of lines terminated on the LU to the time slots available for the LU (64 time slots per LU).

Constructed Feature
Feature defined by a *5ESS*® switch user (such as a service provider) for their particular needs.

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Customization
This is a modification of a preconstructed BRCS feature resulting in a unique feature that can be assigned to lines or trunks.

DALB (D-Channel Application Linkage Block)

DBM (Data Base Manager)
Provides interfaces and access mechanisms between the different types of software systems and data in the data base.

DCBU (D-channel Backup)
Enables a standard PRI to have an "active" and a "stand-by" D-channel.

DCE (Data Communication Equipment)

DCIS6 (Direct Common Channel Interoffice Signaling #6)
A protocol permitting CCIS6 direct signaling messages to be sent over CCS7 signaling links.

DCLU (Digital Carrier Line Unit)
This unit terminates the T1 carrier from the *SLC*® 96 carrier systems to the *5ESS*® switch.

DCO (Digital Central Office)

DCTU (Directly Connected Test Unit)
A unit accessing each line and trunk to provide a number of facility tests required.

DDD (Direct Distance Dialing)
Direct distance dialing is a toll service that permits customers to dial their own long distance calls.

DDL (Derived Data Links)
Data links used to communicate with other RSMs in an multimodule remote switching module (MMRSM) when in a stand-alone mode.

DDS (Digital Data Service/System)
A dedicated digital transport network that provides data communications over point-to-point or multipoint private lines and systematically supports *DATAPHONE*® data communications service. The DDS is designed for digital data only (up to 56 kb/s), there is no provision for voice transmission.

DDSBS (Duplex Dual Serial Bus Selector)
A channel which permits the connection of two dual serial channels to a single I/O device.

DEN (Digital Equipment Number)
A 7-digit number used in translation to identify the location of a DLTU channel so that it may be accessed.

DESEP (Destination Separation Class)
The destination class on the traffic separation report.

DF (Data Fanout)
A pack that provides the distribution of data signals to and from the PHs.

DFA (Digital Facilities Access)
Access point for digital facilities in a *5ESS*® switch.

DFC (Disk File Controller)
A microprocessor-controlled unit that is programmed to accept tasks from the AM, and then assigns each task to a disk drive work queue.

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DFI (Digital Facility Interface)
The circuitry in a DLTU that terminates a single T1 span line from a T-carrier RSM.

DID (Direct Inward Dial)
A feature that allows an incoming call from the exchange network, except foreign exchange or wide area telephone service, to reach a specific centrex or PBX station line (or group of lines if in a hunt group) without attendant assistance.

DISPDB (Display Data Block)

DLI (Dual Link Interface)
Connects the TSI to the NCT links, inserts control messages between the module processor and the AM or other module processors, and provides buffering and timing.

DLN (Direct Link Node)
A node on the CNI ring performing signaling message processing normally performed by the AM. The DLN is connected with other nodes on the ring by way of the dual ring bus.

DLTU (Digital Line Trunk Unit)
Hardware that terminates digital trunks with SMs by way of T1 lines.

DMA (Direct Memory Access)
Provides direct access to the main store by peripheral units without involving the AM.

DMERT (Duplex Multi-Environment Real-Time)
The software operating system program used by the AM.

DMI (Duplex Message Interface)
Circuitry terminating the message interface fuses from the module message processors.

DMMP (Dual Multimodule Processor)
An optional (beginning with software release 5E6) feature allowing equipage of more hardware providing greater reliability of full message transfer capacity in CM2 equipped offices.

DMU (Data Manipulation Unit)
The hardware of the 3BCC containing the rotate/shift mask unit, the arithmetic/logic unit and the general/temporary firmware registers.

DN (Directory Number)
A 7-digit telephone number made up of a 3-digit central office code and a 4-digit station number. It is also called TN.

DNET (Defer Nonessential Tasks)

DNUS (Digital Networking Unit-SONET)
An SM-2000 Unit that functions similar to the DLTU by terminating trunks interfaces to the SM-2000.

DOPS (Digital Ordering and Planning System)
The standard engineering ordering and pricing vehicle for the *5ESS*® switch.

DP (Daily Peak)
The maximum of the CBH loads in a day.

DP (Dial Pulse)
Method of transmitting digits (address information) between telephone customers and the central office or between central offices. It consists of DC pulses caused by momentarily opening the loop (usually at 10 "opens" per second). The numerical value of each digit is represented by the number of opens in a train of pulses.

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DPAT (Dialing Access Plan Treatment)

DPBX (Digital Private Branch Exchange)

DPIDB (Directly Connected Interface Data Bus)
The bus that carries user and control messages between the integrated services line unit (ISLU) and the packet switch unit (PSU).

DS3
A transmission medium that can be fiber-optic or digital radio at a rate of 44.736 MB/s.

DSCH (Dual Serial Channel)
A bus in the CNI that provides packet data transfer between the RPCs, LNs, and the AM.

DSL (Digital Subscriber Line)
A three-channel digital line that links the ISDN customer's terminal to the telephone company switch with four ordinary copper telephone wires. Operated at the BRI, the DSL can carry both voice and data signals at the same time, in both directions, as well as the signaling date used for call information and customer data.

DSN (Defense Switched Network)
A private 4-wire telecommunications network that is used for the transaction of official business of the government at Department of Defense and military installations. The DSN incorporates unique features specific to government applications, including the use of *5ESS*® switches as multifunction switches. The DSN has control to access or limit access to commercial telephone company central office and trunk lines and to restrict commercial access to the DSN as deemed necessary. The terms DSN, AUTOVON, and DSN/AUTOVON are used interchangeably when referring to this network.

DSP (Digital Signal Processor)
A specialized microprocessor used to perform signal processing operations in the universal tone decoder, universal conference circuit, and transmission test facility.

DSU (Digital Service Unit)
A functional part of the SM that generates and decodes tones, tests ISDN lines and CCS trunks, and provides recorded announcements for the OSPS.

DSX (Digital Cross-Connect)
An internal interface that acts as a central point for cross-connecting, rearranging, patching, and testing digital equipment and facilities.

DTA (Dial Through Attendant)
A BRCS feature allowing a station user to complete the dialing of other than station-to-station calls after the attendant selects the private facility on attendant-handled calls.

DTD (Dial Tone Delay)
This is the time it takes the switching system to return dial tone to an originating line after the subscriber goes off-hook.

DTDPC (Dial Tone Delay Peg Count)

DTDSC (Dial Tone Delay Sample Count)

DTF (Dial-Tone-First)
A type of coin service which allows the customer to dial certain types of calls (for example, N11 and other local free calls, 0-, 0+, etc.) without making an initial deposit.

DTMF (Dual Tone Multifrequency)
Method of transmitting digits (address information) from telephone customers to the central office. It

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consists of sending a simultaneous combination of one of a lower group of frequencies and one of a higher group of frequencies to represent each digit (1 through 0), and symbols (* and #).

DTT (Digital Transmission Terminals)

DUCS (Digital Universal Conference Service)
A 3-port or 6-port conference circuit capable of conferencing up to three or six parties, respectively.

Data
Data is any coded information that is taken in, operated on, or outputted by a computer or other machine designed for handling such information. A descriptive type of information used as a basis for making decisions.

Data Base
Electronically stored information which may be retrieved and updated by way of DBM interface primitives.

Data Interface
A subunit of the TSIU that provides the interface for the PCM data, signaling bits and the clock and time-slot synchronization between the TSI and the interface units.

Dial Tone
Dial tone is an audible tone which indicates that a customer digit receiver has been attached and that dialing may begin.

Dictionaries
A data base in the *5ESS*® switch that provides information such as access-type, relation and attribute identifications, number of subattributes, domain identifications, etc., in the memory structure.

Direct Connect
Direct connect allows a customer to signal and be automatically connected to another station by removing the handset from the switchhook.

Disk Drives
Memory storage hardware that uses magnetic recording on rotating flat disks. Disk drives provide reliable and flexible mass memory storage for infrequently used programs and data.

Domain
In a data base, the set of allowable values that an attribute may have.

Dynamic Memory
The equipment used to magnetically store information which is changed frequently, such as equipment and work status, work queues, etc. Dynamic memory, dynamic data, and dynamic ODD are used interchangeably.

E911 (Enhanced 911)
Provides the public safety answering point with caller identification.

E&M (Signaling Leads)
A signaling system that derives its name from historical designations of the signaling leads on the circuit drawings covering these systems. The M-lead carries supervisory (and sometimes dial pulse) signals from the switching equipment to the signaling/transmission equipment. The E-lead carries supervisory signals from the signaling/transmission equipment to the switching equipment. As a result, signals from office A to office B leave on the M-lead at office A and arrive on the E-lead at office B.

EADAS (Engineering and Administration Data Acquisition System)
An automated traffic data collection system which collects and summarizes data obtained from central

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office switches to be used for administrative and engineering purposes.

EAEO (Equal Access End Office)
An *ESS*® switch used to provide carrier access to co-located stations.

EAI (Emergency Action Interface)
The interface connecting craft inputs to the central control for certain maintenance functions.

EAS (Equal Access Signaling)
A signaling method introduced by the carrier interconnect feature.

ECD (Equipment Configuration Data)
A data base that describes the physical and logical configurations (that is, interfaces of IOP and AM) of the 3B20D or 3B21D computer and peripheral hardware. It also contains configuration and control information for the audit and craft interface software system.

ECIS (Embedded CCS Protocol)

ECIS6 (Embedded CCS Protocol #6)
A transmission protocol used for CCS6 banded messages using the link level of the CCS7 signaling protocol message transfer part. This protocol allows the 2STP CCS network to use 56 kb/s signaling links and build up the signaling capacity.

EOP (End-of-Period)
A statistical term used in engineering methodology that denotes the end of a predetermined engineering period. The time between scheduled equipment growth or modification operations.

EPROM (Erasable, Programmable, Read-Only Memory)
A type of ROM (read-only-memory) that can be electrically erased and re-written.

EPSCS (Enhanced Private Switched Communications Service)
A private switched network of dedicated facilities providing full duplex communication on all connections. It provides a center from which the customer can exercise, monitor, and control functions relative to the performance of the network.

EQPOTS (Equivalent POTS)

ESSX (Private Facilities Feature Emulating a PBX)

ETN (Electronic Tandem Network)

ETS (Electronic Tandem Switching)

EVE (Extreme Value Engineering)
A method of engineering a switching system based on the extreme (that is, the highest use, most space required, most lines needed).

EVHD (Expected Value High-Day)
A statistical variable value used in the EVE methodology. The EVHD represents a statistical equivalent of the traditional HD criteria and is based on the three high-month busy season data.

EMM (Expanded Main Memory)

EXM-2000 (Extended SM-2000)
An SM-2000 that performs the functions of a remote SM.

Erlang
A measure of communications traffic intensity representing the full-time use of a communications

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facility. One Erlang equals 36 CCS.

FC (Feature Control)
This is responsible for the sequencing of a call which includes collection of digits and interpretation of customer signals.

FIU (Facilities Interface Unit)
Used between the RSMs and the host SMs and connects the T1 format to the NCT format.

FPC (Foundation Peripheral Controller)
A peripheral control in the input output processor used to provide AM interface to the TMS and maintenance access to the message switch. The FPC issues time slot path requests to the TMS and acts as an interface between the peripheral subunits and the MSGS. In the CM1 configuration, the FPC is part of the MSPU. Under direction of the AM processor, the FPC controls the configuration of hardware in the MICUS. In the CM2 configuration, the FPC is part of the MSCU2. Under direction of the AM processor, the FPC controls the configuration of hardware in the MSCU2s.

FRL (Facilities Restriction Level)

FX (Foreign Exchange Service)
Provides customer access to a distant central office by private (FX) trunks. Incoming foreign exchange calls are placed to the listed (FX) directory number and are answered by the attendant. Outgoing calls may be made on an attendant basis and/or on a station user direct-dial basis.

Fractional DS1 Switching (Fractional DS1/ISDN)
Enables customers to establish calls with other customers at rates between 128 and 1,536 Kbps.

Frame
Overhead control bits usually encapsulating a packet. These bits contain frame delimiters, addresses, error detection information, frame type identifiers, etc. In certain protocols such as X.25, a frame need not contain a packet.

GDSF (Global Digital Service Function)
A single unit that replaces the GDSU, TTF, and ISTF units in the SM. This unit may also be assigned on the SM-2000.

GDSU (Global Digital Service Unit)
A part of an SM that provides up to eight digital service circuits for low usage functions such as 3-port and 6-port conferences, test tones, responses to test tones, and processing test responses.

GDX (Gated Diode Crosspoint)
Electronic devices used to pass current in either direction and used in the LU line concentrator.

Growth
Growth is the systematic modification of central office equipment to provide increased call-handling capacity and improved service. Growth is required to make a *5ESS* ® switch evolve economically over a wide range of services and traffic needs.

Hairpinning
A connection established between one channel on a DS1 (or time slot on a T1) to another on the same IDCU.

HD (High Day)
The one day in a 10-day average that has the highest traffic during the busy hour.

HDBH (High-Day Busy-Hour)
The traffic load level in the BH (busy hour) of the HD (high day).

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HLSC (High-Level Service Circuit)
A service circuit in the LU used to perform all line service circuit functions which cannot be provided through the TSI.

HOC (Host Office Collector)
A centralized AMA data collection system which collects AMA data over data links from several telephone switching offices.

HSM (Host Switching Module)
The SM in the host office terminating umbilicals from one or more RSMs.

Half-Call
A half-call is the establishment of a path between a peripheral unit and the TSI. The terminating part of a call represents a half-call and the originating part of the call represents the other half-call. Each half-call generates a terminal process.

Hundred Call Seconds (CCS)
A unit of traffic. One user using one facility (for example, a trunk) for 1 hour generates 36 CCS (3,600 seconds in 1 hour divided by 100).

I-CNIS (ISDN Calling Number Identification Services
An enhancement to calling party number and billing number feature.

IAO (Intraoffice)
Intraoffice describes calls switched by a single switching machine. Intraoffice equipment is the equipment used to carry traffic between customers within the same switching machine.

IAQ (IP-to-AP Queue)

IC (Inter-LATA Carrier)
A carrier designed to service traffic which crosses a LATA boundary.

ICL (Inter-RSM Communications Links)
The links that interconnect SMs in a multimodule RSM.

ICLID (Incoming Call Line Identification)
This feature provides calling party identification of calls originated from both analog and digital lines on the same *5ESS*® switch for ISDN subscribers and attendants.

IDCU (Integrated Digital Carrier Unit)
A digital loop carrier system supporting Telcordia TR-008 and TR-303 requirements.

IDCU (Integrated Digital Carrier Unit)
Provides analog and ISDN interface to *SLC*® remote terminals.

IDDD (International Direct Distance Dialing)
Customer direct dialing of international calls.

IDP (Individualized Dialing Plan)
The individualized dialing feature of the *5ESS*® switch can be used to incorporate any number of the following special operational functions requested by the customer: critical interdigital timing for dialing plan; attendant control of facilities; group numbering plan that includes intercom dialing by way of 1- to 5-digit basis, access to an attendant by way of the digit "0", access to private facilities via a 1- to 7-digit code, redefinition of feature access codes from the standard POTs codes and overriding the group dialing plan; single-digit dialing; speed calling; and customer-changeable speed calling.

ILUM (Individual Line Unit Measurement)
Allows the administrator to request traffic measurements of any 128 individual lines in the office.

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IMS (Interprocessing Message Switch)
Hardware and software in the SM used to support OSPS, BRCS, CSDSCII, and the ICLID for interoffice calls and 16 kb/s intraoffice packet switching.

INSEP (Incoming Separation Class)
The incoming class of the traffic separation report.

INWATS (Inward Wide Area Telephone Service)
Calls to area code 800 subscribers from one or more predetermined geographical areas at a rate based on expected usage. These calls are toll free to the calling parties.

I/O (Input/Output)
Input/output is the process of transmitting information from an external source to an external destination.

IOMI (Input-Output Microprocessor Interface)
A unit that provides the interface between the 16-bit PIC and up to 16 of the 8-bit MMPs.

IOP (Input Output Processor)
The IOP controls transfers between the MAS of the AM and the MCC, operation and maintenance center, and remote terminals. The IOP provides interfaces to visual display units and hard-copy printers in the MCC, other work stations, and to magnetic tape drives.

ISAT (Integrated Services Attendant Console)

ISDN (Integrated Services Digital Network)
An international plan originated by the ITU-T representing the latest step of the evolution of the analog telephone to an all-digital network. Digital voice, circuit-switched, and packet-switched data may be transmitted simultaneously over the same interface.

ISLU (Integrated Services Line Unit)
This unit houses the basic rate interface (BRI) cards in the SM and provides analog and digital services to subscribers by support of the following interfaces: ISLU-T, a 4-wire BRI that provides the basic Integrated Services Digital Network 2B+D access over a range of up to 1,000 meters; ISLU-U, a 2-wire BRI that provides the basic ISDN 2B+D access using echo-canceled hybrid technology appropriate for all carrier serving area nonloaded loops; ISLU-Z, for analog lines (that is, POTS, coin-first coin lines, party lines, etc.) which normally terminates on the analog-concentrated line unit. The ISLU-Z interface can have a concentration ratio of up to 8:1.

ISM (Integrated Services Module)

ISP (Intermediate Switching Point)

ISTF (Integrated Services Test Facility)

ISUP (ISDN User Part)

ITU-T (Telecommunications Standardization Sector)
Successor to CCITT.

IU (Interface Unit)
Part of the *5ESS*® switch that provides customer terminations.

Incoming Calls
These calls originate (as far as the switch is concerned) on trunks and are routed either to other trunks (tandem) or to lines.

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Incoming Response Delay
This is the time from the arrival of an incoming seizure signal to the return by the receiving exchange of a proceed to send or an equivalent signal.

Interoffice
Interoffice describes calls between two or more switching machines. Interoffice is the trunk groups between two separate switching machines or the traffic carried by such trunk groups.

kB (Kilobyte)
1024 bytes.

KIP
Kilobytes in Progress

Key
Designation assigned to one or more data base attributes that will provide access to a particular tuple.

Key Service Indicators
These indicators give the administrator a quick view of the overall quality of service being provided to the subscribers.

LAMA (Local Automatic Message Accounting)
A message accounting system located within a local office and serving on subscribers assigned to that office or group of offices.

LAN (Local Area Network)
An ISDN feature introduced in software release 5E4 allowing packet switching over a 16 kb/s D-channel on a BRI. Access for individual subscribers is by the standard 2B + D format. Packet-switched data and signaling is carried on the 16 kb/s D-channel. Computer access is available using one or more digital subscriber lines carrying multiplexed packet data on the 64 kb/s B-channel.

LAPD (Link Access Protocol D)

LASS (Local Area Signaling Services)

LATA (Local Access and Transport Area)
A defined geographical area where equal access end offices and/or access tandem offices can provide carrier access to the local exchange.

LDIT (Local Digit Interpreter Table)

LDN (Listed Directory Number)
The LDN calls originate outside the customer group and complete to a centrex attendant.

LDSU (Local Digital Service Unit)
A part of the SM that provides high-usage service circuits such as tone decoding, tone generation, conferencing and voice-frequency testing.

LDSUB (Local Digital Service Unit Bus)
A data connection terminating the time slot interchanger in the MCTU and the serial data interface circuit on the DSC pack. The LDSUB is the path over which digitized tone samples pass to and from the DSU2.

LDSUF (Local Digital Service Unit Function)
Part of the DSU2 that generates and decodes tones.

LEN (Line Equipment Number)
An 8-digit number used in translations to identify a customer's line so that it may be accessed.

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LGC (Line Group Controller)
The interface between switched information on the group interface data bus and the link interface data bus.

LIDB (Line Information Data Base)
A-32-time slot bus that connects the line group controllers (LGC) and the common data boards in the ISLU.

LMOS (Loop Maintenance Operations System)

LN (Link Nodes)
A part of the CNI that performs the message handling protocol, control functions, and self-diagnostics. The LN establishes the connection to the signaling network by way of A-links.

LONAL (Local Off-Network Access Line)

LSS (Load Service Summary)
This report provides load volumes, processor occupancies, and ineffective attempt information.

LTD (Local Test Desk)
The local test desk provides equipment that performs local primary line testing. It may be used to test parts of the toll

LTMA (Lightwave Termination and Multiplex Assembly)

LTP (Line Trunk Peripheral)
Consists of the LU, TU, MSU, DCLU, FIU, and the modular metallic service unit.

LU (Line Unit)
This unit interfaces the analog (subscriber) lines to the SM of the *5ESS*® switch.

LUCUM (Line Unit Concentrator Utilization Measurements)
Enables the administrator to request traffic measurements on individual line to determine if they are experiencing blocking, to assist in determining what lines are being affected, and indicate how the call load may be redistributed to alleviate a high blocking situation.

Lightwave Termination and Multiplex Assembly (LTMA)

Locally Switched Lines
Lines that are dynamically switched within an office containing an IDCU.

LUTS (Locked Up Trunk Scan)

Loss Probability
The loss probability is the failure to connect a call after sufficient address signaling information (dialed digits) has been received. It includes network and service circuit blocking and any system faults, but excludes trunk blocking.

***MACSTAR*® Computer Program**
A Lucent Technologies 3B2 computer program used as a front-end adjunct to the Remote Memory Administration System (RMAS) as part of the CSR (customer station rearrangement) feature.

MAS (Main Store)
The MAS is RAM which in the AM contains information needed for operating the *5ESS*® switch, such as the software release for AM functions, translations, call processing registers and billing registers. The MAS is duplicated for reliability.

MASU

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See MAS.

MB (Megabyte)
Consists of 1,048,576 bytes.

MCB (Message Control Block)

MCC (Master Control Center)
The MCC provides the local human-machine interface to the *5ESS*® switch including system status displays, hard-copy printers, and manual control over system operations.

MCD (Minimum Chargeable Duration)
The minimum chargeable duration is the length of time that answer supervision has been continuously detected, beyond which a call is defined as billable. The MCD period is 2 seconds.

MCTU (Module Controller and TSI Unit)

MDF (Main Distributing Frame)
This is a connection system that interfaces between loop cable pairs and switching equipment.

MDR (Message Detail Recording)

MDSL (Multiplexed Digital Subscriber Lines)

MEU (Memory Expansion Unit)
Hardware that provides additional memory capacity for SMs and/or RSMs.

MF (Multifrequency)
Signaling method in which pairs of selected tones, representing digits, are sent to the common control switching system. Voice transmission from the calling customer is inhibited during MF pulsing.

MFC (Modular Feature Construction)
A type of software construction used in BRCS version of the *5ESS*® switch that permits simplified grouping of several capabilities into feature groups that provide many revenue producing services, tailored to individual customer needs.

MFOS (Multifunction Operating System)

MGRNR (Message switch receiver not ready)

MHD (Moving Head Disk)
A high-capacity, random-access digital data storage device used for storing infrequently accessed programs and data by the AM.

MIB (Message Interface Bus)

MICU (Message Interface Control Unit)
This is a unit in a message switch which consists of the network clock and the NCT link interface from the message switch.

MLH (Multiline Hunt)

MLHG (Multiline Hunt Group)
A group of customer facilities which are identified as a group in translations. When calls are placed to the MLHG, the *5ESS*® switch hunts for an idle member of the group beginning with the dialed DN.

MLSS (Machine Load and Service Summary)
This report provides cumulative service year-to-date and additional capacity information for each SM.

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MLT (Mechanized Loop Testing System)
An external operations system for testing of the customer lines (loops) in the *5ESS* ® switch.

MMC (Maintenance Message Consolidation)

MMP (Module Message Processor)
Circuitry in the MSPU that handles control message protocol on the link to the SMs.

MMRSM (Multimodule Remote Switching Modules)
The MMRSM consists of one to four RSMs interconnected by dedicated T1 links. Each RSM is also connected to an SM at the *5ESS*® switch by dedicated T1 links.

MMSU (Modular Metallic Services Unit)
Provides metallic access, miscellaneous scanning and distributing functions, automatic line insulation test, and gated diode crosspoint compensation.

MPI (Module Processor Interface)

MS (Main Station)
A telephone that is connected directly to the central office either by an individual or shared line. Main stations include the principal telephone of each party or a party line. They do not include telephones that are manually or automatically connected to the central office through a PBX or extension telephones (telephones that have been added to an individual or shared line to extend the telephone service to other parts of the subscriber's home or business premises).

MSCU (Message Switch Control Unit)
The MSCU is a part of the CM and is responsible for handling control information between the AM and module processors.

MSG (Message Switch)
This is the unit that performs internal interprocessor message switching, provides terminations for CCS (common channel signaling), and contains the message interface clock unit.

MSGS (Message Switch)
The MSGS, one of two switches that comprise the CM, performs as a switch for passing control messages between any two SMs or an SM and the AM. The TMS is the other switch in the CM.

MSPU (Message Switch Peripheral Unit)
Hardware unit of the CM that switches interprocessor messages on the control time slots.

MSPU3 (Message Switch Peripheral Unit 3)
An improved version of MSPU1 and MSPU2 that includes MMP. The MSPU3 reduces software required for message handling and required processor real time per message.

MSS (Message Service System)
The MSS (also known as the Customer Service System) is a feature introduced in software release 5E4 that offers the business customer personalized call answering from a centralized location. In addition to the call coverage functions, MSS supports entry, storage, and retrieval of messages.

MSU (Metallic Service Unit)
Provides an access network in the *5ESS*® switch which can interconnect analog facilities and DC test equipment; provides scan and distribute functions, metallic access, automatic line insulation testing, and gated diode crosspoint compensation.

MTB (Metallic Test Bus)
The bus connecting the modular metallic service unit to the test access circuit within each trunk unit. This bus is used for maintenance and routine test activities.

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MTIB (Metallic Test Interface Bus)
See MTB.

MTTY (Maintenance Teletypewriter)
The human-machine interface to the administration module.

MUPH (Multiple Position Hunt)
A BRCS feature introduced in software release 5E2(1) that distributes calls over a group of console positions, each of which can handle several types of calls. Each position has dedicated terminals, rather than call indicator lamps, for receiving the different call types.

MWI (Message Waiting Indicators)
An ISDN feature introduced with software release 5E4 informing a customer of a message waiting. Three types of indicators can be provided.

(1) ***Audible Message Waiting Indicator*** : Provides a tone when the customer goes off-hook.

(2) ***Electronic Billboard***: Provides name of person having messages.

(3) ***Visual Message Waiting Indicator*** : Activates a message waiting lamp on the station set.

Manual Line Service
Manual line service is a centrex feature which allows a centrex station to be connected to an operator or attendant by taking the receiver off-hook, without dialing any digits. Manual line service is similar to direct connect, a noncentrex feature.

Maximum Call Capacity
This is the capacity of an ideal switch with a central processing unit with 73 percent call processing occupancy and 98 percent processor occupancy. This call capacity is a level that is sustainable for an indefinite period of time; however, no allowance is made for craft interaction.

Message
A message is used to pass information between processes. A message may consist of data, requests, commands, and/or acknowledgments. The message count represents the number of messages exchanged between processors.

Metallic Test Interface Bus (MTTB)
See MTB.

Modular Queuing Capability
A BRCS feature that provides, in the TRFC30 report, measurements on the queues and announcements.

Multiparty Service
Provides 4- or 8-party telephone service to a maximum of eight customers on a common line.

NAC (Network Administration Center)
A work group interfaced to the SCCS (Switching Control Center System) and designated to automatically receive the following: TRFC30 reports; 5-minute, 1-hour, 24-hour and monthly plant reports; and TRFC30 reports upon request.

Nail-Up
A connection established between any channel on a DS1 to any other specified time slot on a peripheral unit of the *5ESS*® Switch.

NCD (Network Call Denial)
This capability enables a carrier switch to block inter-LATA calls from non-paying customers.

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NCLK (Network Clock)
The digital reference clock for the network.

NCT (Network Control and Timing)
A fiber-optic path which connects an SM to the TMS, provides time-slot paths for network connections, carries a control time slot to the SM, and distributes timing to the SM.

NFAS (Nonfacility Associated Signaling)
Provides a D-channel signaling channel which can control calls to DS0 channels on more than one PRI for a Telcordia standard PRI.

NM (Network Management)
This is a real-time surveillance and control activity utilizing techniques to optimize use of the call carrying capacity in a network under stress due to traffic overload or failure.

NMC (Network Management Center)

NOCKT (No Circuit)

NPA (Numbering Plan Area)

NRODD (Nonredundant Office Dependent Data)
Office dependent data that is not backed up (call processing data, for example).

No Circuit
This represents the number of calls lost due to unavailable resources.

OA&M (Operations, Administration, and Maintenance)

OAM Load (Once-A-Month Load)
A statistical variable value used in EVE methodology, that indicates the traffic load which is expected to be exceeded only once a month. This is defined as the 95th percentile of the DP distribution.

ODA (Office Data Assembler)
The mechanism by which initial translation information may be assembled for a *5ESS* ® switch. Information for the *5ESS*® switch is entered by way of a video terminal and transferred into an ODA computer, assembled, then sent to the *5ESS*® switch.

ODB (Office Data Base)

ODBE (Office Data Base Editor)
A feature of the *5ESS*® switch memory management that allows manual changing of information contained in the data base.

ODD (Office Dependent Data)
A data base specific to a particular office.

ODD (Static)
Data that establishes the types and amounts of various equipment which comprise the office (lines, trunks, equipment, etc.). The protected area of memory.

OGT (Outgoing Trunk)
An outgoing trunk is a 1-way trunk where only originating traffic can access a distant office to complete telephone calls. Originating traffic in the distant office cannot access this trunk.

OM (Output Message)

ONAL (Off-Network Access Line)

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ONTC (Office Network and Timing Complex)

ONI (Operator Number Identification)
A method to obtain billing information by connecting the calling party to an operator position.

OOS (Out of Service)

ORB (Office Repeater Bay)
A bay in the office, usually near the digital system cross-connect bays, that houses the digital repeaters used to regenerate the PCM data for a T1 line.

ORM (Optically Remoted Switching Module)
A type of remoted SM that is interfaced to the *5ESS*® switch through the CM instead of a host SM. This is done by way of DS3 transmission or T1 facilities (fiber-optic, digital radio, cable, or T1) at a rate of 44.736 MB/s.

ORP (Office Records Printer)
A local or remote printer that uses a 7N47B to interface into the input/output processor (IOP). This is an RS232C interface for a full duplex, asynchronous, 1200-baud terminal. If the ORP is remoted, a modem and a dial-up line must be used to establish the data link.

OS (Operating System)
Software that enables a computer to supervise its own activity.

OSDS (Operating System for Distributed Switching)

OSO (Originating Screening Office)
This feature allows the *5ESS*® switch to screen originating 800 service calls. Routing information is obtained by accessing a remote data base.

OSO-INWATS
800-Service originating screening office.

OSPS (Operator Services Position System)
The OSPS uses features provided by a host *5ESS*® switch and dedicated peripheral equipment to support operator and attendant services.

OSS(Operational Support System)
Computer systems which may be used to provide additional administrative support (for example, EADAS, COER, SCCS, etc.)

OTC (Operating Telephone Company)
Telephone Company owning *5ESS*® switch.

OUTWATS (Outward Wide Area Telephone Service)
A service that allows customers to make calls to certain zone(s) or band(s) on a direct dialing basis for a flat monthly charge or a charge based on accumulated usage. Users can also call WATS operators for assistance.

OVLD (Overload)

OVLDEN (Calls denied due to overload)

Office Records
Office records for the *5ESS*® switch are tabular listings of the actual inventories and assignments of the data base and serve as a means for administering the office. An explanation of the form entries is included in the translation guide TG-5.

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Operational Capacity
This capacity is the indefinitely sustainable operation point while processing calls with an ideal, fault-free exchange and an unlimited supply of internal resources and external facilities.

Originating Calls
These calls originate on lines and are routed to either other lines (intraoffice) or to trunks (interoffice).

Outgoing Calls
These calls are routed to trunks.

Overflow Count
Overflow count is a cumulative count of the number of call attempts which failed to seize a member of a specified group of facilities because no idle member was available.

PB (Packet Bus)
The packet interface between the PSU and the MTCU.

PBX (Private Branch Exchange)
A customer premises switching system.

PC (Peripheral Controller)
Circuitry in the input-output processor that interfaces with peripheries outside the *5ESS*® switch AM.

PCB (Process Control Block)

PCM (Pulse Code Modulation)
A technique for coding analog signals for transmission on a digital circuit.

PDB (Process Data Block)

PDN (Packet Data Network)

PF (Packet Fanout)
A pack that provides the distribution of data packets to and from the PHs.

PFA (Private Facilities Access)
This feature allows subscribers to have dial access to various types of public and private switching arrangements.

PH (Protocol Handler)
Circuitry that switches control messages between the BRI and the MCTU.

PHDB (Protocol Handler Data Bus)
Data bus internal to the PSU that is the interface between the PH and the data fanout circuitry.

PI (Packet Interface)
MCTU pack that controls packet data interface to and from peripheral units.

PIB (Packet Interface Bus)
Packet bus internal to the PSU; that is, the interface between the packet fanout and the control fanout circuitry.

PIC (Peripheral Interface Controller)
The PIC controls the movement of commands and data between the AM processor and the peripheral controllers.

PICB (Peripheral Interface Control Bus)
A duplex set of wires carrying control information between the module controller and an interface unit

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on the SM.

PID (Process Identification)

PIDB (Peripheral Interface Data Bus)
A duplex set of wires providing 32 time slots between the data interface and interface units.

POTS (Plain Old Telephone Service)
Basic voice service by way of telephone.

PP (Precedence and Preemption)
Customers on the AUTOVON interface switch may be assigned the local PP feature. This feature provides six levels of precedence calling: flash override (FO); flash (F); immediate (I); priority (P); executive override (EO); and routine (R). An FO precedence level call has the highest precedence, and an R call has the lowest precedence. The local PP feature is used for intraoffice calls on the local AUTOVON interface switch. Precedence and preemption is also used for AUTOVON calls (calls involving the AUTOVON tandem switch). In the AUTOVON network, five levels of precedence calling are used. The precedence levels in the AUTOVON network are the same as the local PP calling precedence levels with the exception of the EO level. Preemption refers to the act of interrupting (and terminating) an existing call to establish a higher level precedence call.

PPC (Pump Peripheral Controller)
Circuitry in the MSGS that is responsible for the rapid reinitialization of the SM in case of total failure of the SM.

PPSN (Public Packet Switch Network)

PRI (Primary Rate Interface)
An ISDN feature supporting digital interface to digital PBX on a primary rate carrier (1.544 MB/s).

PSIU (Packet Switch Interface Unit)

PSM (Packet Switch Module)

PSU (Packet Switch Unit)
The PSU contains circuitry that provides a centralized high bandwidth interface to support packetized signaling messages and packet data switching. The PSU is a part of the SM and occupies from one to five equipment shelves in a single cabinet.

PTSB (PIDB Time Slot Block)

PU (Peripheral Unit)
Equipment such as the LU, TU, DLTU, DCLU, and GDSU which work in conjunction with but are not a part of the AM, CM or SM. Peripheral units reside in the SM.

Packet
A group of bits that is switched as an integral unit. Typically, packet contains data, destination and origination information, and control information, arranged in a particular format.

Pages
Fixed-length areas of memory in which relations (data tables) are stored.

Parameters
Parameters define resources (lines, screening indexes, BRCS) which are used as key attributes in data base relations to describe the makeup of the *5ESS*® switch.

Path Hunting
This is a routine used by the *5ESS*® switch to select the A- and B-link that connect a given line with an

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available channel circuit. In addition to finding this path, the path hunt software updates the A- and B-link status maps.

Peak Call Capacity
This is the capacity of an ideal switch with a central processing unit with 87 percent call processing occupancy and 99 percent processor occupancy. This occupancy level can be sustained for short periods of time (approximately 1 second).

Peg Count
A cumulative count of the number of times a specified event occurs during a given time interval. In some cases, the event may be an attempt to take some action, not necessarily a successful attempt.

Percent Occupancy
This is a percentage of time the processor spends doing call processing and other nondeferrable work.

Plant Measurements
These measurements provide data to evaluate equipment and craft performance.

Poisson Capacity Table
A statistical table, based on a theoretical mathematical formula, that is used to estimate the types and amounts of telecommunications equipment required to provide certain levels of service to a known or projected number of subscribers.

Preconstructed Feature
Feature defined by Lucent and is available to all *5ESS*® switch users (service providers).

Protocol
An agreed-upon procedure for transmitting information between two or more entities.

QGP (QLPS Gateway Processor)
Provides the interface between the QLPS and the CM.

QLI (Quad Link Interface)
The QLIs terminate the NCT links from each of the hosts and local SMs. The fabric provides the space switching of the time slots received over the NCT links.

QLPS (Quad Link Packet Switch)
A high-bandwidth message transport network between the SM-2000 and other components of the *5ESS*® switch.

QKEY Trunks
Trunks which are either outgoing first-in-first-out hunted or outgoing rotate hunted.

RAF (Recorded Announcement Function)
A feature of the 5E4 and later software releases, that provides independent playback of prerecorded, variable length, and variable content OSPS (Operator Services Position System) announcements.

RAI (Recorded Announcement Interface)

RAM (Random Access Memory)
A type of memory that can be both read from and written to. It can contain resident information (static) or transient information (dynamic).

RAO (Revenue Accounting Office)
A telephone company central computation center where per-message charges are calculated from AMA billing data, combined with other fixed monthly charges, and prepared for delivery to telephone customers.

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RAU (Recorded Announcement Unit)
A totally electronic storage device (no moving parts) which uses magnetic bubble memory to store recorded messages in digital form. Using a maximum of four 13A announcement machines, the RAU provides up to 32 channels of recorded messages.

RBHC (Regional Bell Holding Company)

RC (Recent Change)
This is the ability to change the system data base to reflect changes in customer or system capabilities.

RCF (Remote Call Forwarding)
This BRCS feature provides for all calls to a specified local DN to be forwarded to a remote 7- or 10-digit telephone number. The customer specifies the maximum number of simultaneous RCF calls.

REORD (Reorder)

REORG
A memory reorganization that may be needed when the processing speed is reduced.

RISLU (Remote Integrated Services Line Unit)
The RISLU terminates digital and analog lines. It consists of an ISLU and a DLTU-R, and it is connected to a host SM by T1 carrier. The RISLU may be located up to 150 miles from the host *5ESS*® switch. The RISLU is a remote version of the central office equipment and provides analog and digital services (including some *5ESS*® switch features) to remote subscribers. The RISLU provides up to 496 terminations and can be remoted over 24- and 30-channel pulse code modulation facilities. The RISLU provides the same three types of interfaces (T, U, and Z) as the ISLU.

RLI (Remote Link Interface)

RLT (Release Link Trunk)

RMAS (Remote Memory Administration System)
An operational support system used to load translation changes into the *5ESS*® switch.

RODD (Redundant Office Dependent Data)

ROM (Read-Only Memory)
Memory whose data content is preset by the manufacturer. Data content in ROM will not change even if power to memory is removed.

ROP (Receive-Only Printer)
The printer used only for receiving messages at the MCC.

RP (Revertive Pulse)
A signaling pulse made by an LDSU transceiver to another LDSU transceiver on the same line. The LDSU2 does not provide RP transceivers.

RPC (Ring Peripheral Controller)
A part of the CNI that transports signaling messages and internal control CNI/IMS messages between the AM processor and the ring by way of a dual serial channel. The RPC node does not provide network connection. The *5ESS*® switch uses two RPCs.

RR (Remoting Remote)

RSM (Remote Switching Module)
This is a type of SM that is located a considerable distance away from the *5ESS*® switch. The RSM

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provides the switching capabilities of the *5ESS*® switch to areas that cannot economically support an *ESS*™ switch.

RT (Remote Terminal)
A software release term denoting the remote vehicle in any pair gain or remote switch systems.

RTR (Real Time Reliable)

Relation
A rectangular data table (matrix) that has rows called tuples and columns called attributes.

Reorder Tone
Reorder tone is an audible low tone signal (interrupted at a 120-IPM rate) sent to the calling party to indicate that the call cannot be completed due to busy or unavailable equipment. Reorder tone is sometimes called fast busy.

Route Index
A code used in selecting the path a call will take through an office.

SAPI (Service Access Point Identifier)

SAS (Service Announcement System)
An announcement system that provides transparency with the existing RAF platform to provide DTA, AOC, and DA announcements.

SCA (Selected Call Appearance)

SCB (Stack Control Block)

SCC (Switching Control Center)
A centralized location from which the operations for one or more switches can be monitored and controlled.

SCCS (Switching Control Center System)
A system that centralizes control, administrations, and maintenance of the switching systems for several central offices.

SCP (Service Control Point)

SCSI (Small Computer System Interface)
An industry standard interface between the AM and (SCSI) disk drives. This interface is available beginning with software release 5E6.

SDN (Switched Digital Network)

SFG (Simulated Facilities Group)

SG (Service Group)
The maximum set of resources which can be affected by a single hardware fault.

SILC (Selective Incoming Load Control)
A feature that prevents the spread of traffic congestion from IC networks into the local network switching system by limiting the maximum rate of processing IC incoming calls.

SIP (Session Initiation Protocol)
A feature that allows the *5ESS*® switch to operate as a gateway for interworking from the Time Division Multiplexing (TDM) based Public Switched Telephone Network (PSTN) trunks to next generation Internet Protocol (IP) network virtual trunks.

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SLC® 96 Carrier
A digital loop carrier pair gain system used as a supplement or replacement for cable. It serves up to 96 subscribers over T1 transmission facilities.

SLE (Screen List Editing)

SLIM (Subscriber Loop Interface Module)
Replaces the standard office repeater bay used in direct mode I or II interfaces and terminates T-carrier from mode III shelves in D4 format.

SM (Switching Module)
The SM connects all external lines and trunks to the *5ESS*® switch and handles most of the call processing tasks. The SM converts signals received from the lines and trunks into internal digital time-division format of the office.

SMC (Switch Maintenance Control)

SMP (Switching Module Processor)
The SMP is a part of the SM that performs call-processing functions for lines and trunks terminating on the SM and maintenance functions for the SM equipment. There are two SMPs (an active and standby) in each SM. Each SMP is augmented by a separate signal processor located in the TSIU (time slot interface unit).

SMPU (Switching Module Processor Unit)
The SMPU is a part of the SM and consists of a duplicated SM processor (model 2) and the bootstrapper.

SM ODD (SM Office Dependent Data)

SONET (Synchronous Optical NETwork)
A standard universal data transfer format

SP (Signal Processor)
Circuitry in the SM that performs supervisory scanning. It also detects incoming bylink pulses from step-by-step offices.

SPCS (Stored Program Control System)
A system whereby control circuitry executes a series of basic, internal instructions that make up the machine language of the device being controlled.

SST (Short Supervisory Transition)
An SST is a recognized on-hook to off-hook transition signal in which the off-hook state is less than the minimum chargeable duration interval, and the on-hook state is less than that required to release the connection.

STLWS (Supplementary Trunk Line Work Station)
Additional (one or more) trunk test facilities (digital), usually in larger offices, that provide the craftsperson access to the TLWS (trunk and line work station) by way of the MCC (master control center). The STLWS need not be physically close to the MCC.

STP (Signal Transfer Point)

Screening
A translation process to determine what type of treatment a line should be given. Screening information is used in the routing process.

Service Measurements

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These measurements provide data used to evaluate the quality of telephone service to the customer.

Signaling Leads (E&M)

A signaling system that derives its name from historical designations of the signaling leads on the circuit drawings covering these systems. The M-lead carries supervisory (and sometimes dial pulse) signals from the switching equipment to the signaling/transmission equipment. The E-lead carries supervisory signals from the signaling/transmission equipment to the switching equipment. As a result, signals from office A to office B leave on the M-lead at office A and arrive on the E-lead at office B.

Software Release

The software release is a fixed software program that makes up the basic operating system and is the same in all *5ESS*® switch offices with the same program name and issue. It uses individual office translations to allow different features from office to office. This software program was formerly know as ``generic''.

Software Update

A electronic message containing a software release ``fix'' or update that is disseminated on a priority or urgent basis.

Software Updates

Messages, distributed by SCANS, that contain software changes (binary overwrite data) in stored program control programs and/or related data for craftsperson.

Space Division

Space division is a method of serving a number of simultaneous calls by assigning different physical transmission paths through a switching network to those calls. In the *5ESS*® switch, the space division switching is performed by the TMS.

Speed Calling

This feature allows the customer to associate some digit string with a 1- or 2-digit code. The *5ESS*® switch looks up the corresponding digit string and routes the call according to it.

Stable Call

After all the switching functions are completed and a talking state (the called party answers the telephone) is reached, a stable call is established.

Static Memory

Equipment used to store information which is changed infrequently, such as, characteristics of a particular telephone office (types and amounts of equipment, lines, trunks) and features associated with telephone numbers. Static memory, static data, and ODD (office dependent data) are used interchangeably.

Switching Delay

This is the time from arrival of sufficient address information until the exchange starts sending a seizing signal on an outgoing circuit, a calling signal on a subscriber line, or another appropriate indication (for example, congestion tone).

System Process

Software process that exists as long as the *5ESS*® switch is functioning. System processes are associated with non-call-processing tasks such as maintenance and billing functions.

T1

A 24-channel PCM channel wire or cable transmission medium operating at a rate of 1.544 MB/s.

T&A (Toll and Assistance)

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TAC (Test Access Circuit)

TCB (Time Control Block)

TCBH (Time-Consistent Busy-Hour)
The four consecutive 15-minute intervals commencing at the same time each day for which the average traffic is the greatest during the days of observation.

TD (Tone Decoder)
The TD resides in the LDSU of the SM and performs digit reception and decoding functions for dial pulse and touch-tone originating calls from lines.

TDAD (Trunk Decoder Time Delay)

TEI (Terminal Endpoint Identifier)

TEN (Terminal Equipment Number)
A 7-digit number used in translation to identify the location of a DCLU channel or trunk circuit so that it may be accessed.

TDUSG (Dial Tone Total Usage)

TEO (Telephone Equipment Order)
The order to Lucent Technologies specifying equipment required to construct the desired *5ESS*® switch office.

THD (Ten High-Day)
The ten busiest days during the ABS (average busy season) in terms of observed TCBH (time-consistent busy-hour) load.

THDBH (Ten High-Day Busy Hour)
The average traffic load in the TCBHs of the THDs.

TLWS (Trunk and Line Work Station)
Provides local craft access for lines and trunks, an interface to circuit administration, and supports portable testing equipment for the *5ESS*® switch.

TMS (Time Multiplexed Switch)
The TMS, one of two switches that comprise the CM1, performs the time-shared space division switching such as voice and data between any two SMs or between an SM and the AM. The MSGS is the other switch in CM1.

TMSLNK (TMS NCT Link)
See NCT.

TMS NCT Link (TMSLNK)
See NCT.

TMSU (Time Multiplexed Switch Unit)
Circuitry within the TMS that terminates 30 NCT links and performs space switching of the time slots received.

TN (Telephone Number)
A 7-digit telephone number made up of a 3-digit central office code and a 4-digit station number. It is also called DN.

TOD (Time of Day)
This feature provides the ability for COERs to be automatically scheduled at particular times during

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the day and on particular days of the week.

TOPAS (Test Operations, Provisioning, and Administration System)

TRK (Trunk Group)

TRM (2-Mile Optically Remoted Module)
An SM located up to 2 miles from the CM and connected by a multimode optical fiber that serves as an extended NCT link.

TSDB (Time Slot Data Base)

TSI (Time Slot Interchanger)
This is the equipment arrangement in the SM that takes information coming to it or from the TMS and switches it onto the time slot corresponding to the line or trunk involved in the call.

TSIU (Time Slot Interchange Unit)
The TSIU is the part of the SM that performs time slot switching. The TSIU consists of a TSI, data interface, dual link interface, control interface, and signal processor.

TSS (Time Slot Set)
A group of 64 time slots assigned to a peripheral unit (LU, TU, DCLU, DLTU, or GDSU).

TTF (Transmission Test Facility)

TTY (Teletypewriter)
An output device used to print information within the switch in a form readable by humans.

TU (Trunk Unit)
Hardware that terminates 64 local or toll interoffice analog trunks without concentration. A minimum of one is required for each office.

TUP (Telephone User Part)

Telephone Equipment Order (TEO)
The order to Lucent Technologies specifying equipment required to construct the desired *5ESS*® switch office.

Telephone Number (TN)
A 7-digit telephone number made up of a 3-digit central office code and a 4-digit station number. It is also called DN.

Terminal Group
A way of associating two or more lines and/or trunks.

Terminal Process
A software process in the SMP which controls a terminal (line, trunk, or channel) during a call or call attempt. The terminal process is created and exists only as long as the terminal it controls is active.

Terminating Calls
These calls are routed to lines.

Time Division
Time Division is a method of serving a number of simultaneous calls by assigning different time slots through a switching network to those calls. In the *5ESS*® switch, the time division switching is performed by the TSI.

Traffic Measurements

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These measurements provide the current status of the *5ESS*® switch as well as indications to support the switching system with additional resources.

Traffic-Sensitive Component
A group of servers that provides less that 100 percent switched capacity.

Transient Call
A transient call is a telephone call that is not in a stable (talking) connection. Examples are dialing, ringing, etc.

Trunk
A trunk is the facility between two different entities; such as central offices and sections of the same switching system, and is used for transmission and/or signaling.

Trunk Circuit
The trunk circuit of a switching system is used to supervise a connection within the system and/or to associate the system with a transmission facility or another switching entity.

Tuple
This is a row in a data table (relation).

Two-Party Service
Provides telephone service to a maximum of two customers on a common terminal appearance on the network.

UCC (Universal Conference Circuit)
A service circuit (3- or 6-port) used to connect 3 to 6 customers for service features.

UCD (Uniform Call Distribution)
A type of line hunting providing an even distribution of incoming calls among the available members of a hunt group.

UNP (Uniform Numbering Plan)
A customer-specified 7-digit numbering plan identifying all business group stations interconnected by the facility network. Each customer switch connected by the ETN is identified by a 3-digit code. Stations on the switch have 4-digit extension numbers. More than one 3-digit code can be used per customer premises switch to accommodate additional station numbers.

Uniform Numbering Plan (UNP)
A customer-specified 7-digit numbering plan identifying all business group stations interconnected by the facility network. Each customer switch connected by the ETN is identified by a 3-digit code. Stations on the switch have 4-digit extension numbers. More than one 3-digit code can be used per customer premises switch to accommodate additional station numbers.

UODD (Unprotected Office Dependent Data)
This term is interchangeable with Dynamic ODD.

UTD (Universal Tone Decoder)
Decodes dial pulse, multifrequency, and touch-tone signals.

UTG (Universal Tone Generator)
Creates digital tones for touch-tone, busy tone, dial tone, and multifrequency.

Usage Count
Usage count is a measure of the total amount of time the members of a group of facilities are busy during a given interval. Usage is obtained by examining a specified group at regular intervals and accumulating the number found in a busy state at each scan over a fixed period of time.

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Usage □ Maintenance

The number of times that a component was unavailable for customer traffic due to conditional maintenance. Usage is obtained by examining a specified group at regular intervals and accumulating the number found in a busy state at each scan over a fixed period of time. The maximum usage is obtained on a 100-second scan basis.

Usage □ Total

The total load measured on a group of facilities, whether the load is customer generated or due to a maintenance busy condition. The total usage is obtained on a 100-second scan basis.

Usage □ Traffic

The generated load excluding maintenance busy usage. The traffic usage is obtained on a 10-second scan basis.

VAR (Variable)

VDT (Video Display Terminal)

VLMM (Very Large Main Memory)

VPA (Voice Path Assurance)

A test providing a voice path for common channel signaling trunks. This test ensures the integrity of the voice path inasmuch as the voice and signaling paths are separated on CCS trunks.

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